Pit and Quarry

Published Every Other Wednesday for Producers and Manufacturers of Sand, Gravel, Stone, Cement, Gypsum, Lime and Other Non-Metallic Minerals.

Subscription price $5 for 3 years; $2 for 1 year. Single copies 25c.
Canadian and Foreign Subscriptions $1 additional for each year.

Copyright 1928 by Complete Service Publishing Company

Vol. 16 CHICAGO, ILL., APRIL 25, 1928 No. 2

FEATURE CONTENTS

Excellent Quarry Bottom Shot Made by American Crushed Rock Company ... 47
R. N. Van Winkle, general manager of this company, tells the details.

Salvaging Stone and Gravel Roads With Asphaltic Surfaces 51
W. H. Rhodes explains how it is done in the Southwest.

Increasing Production Per Man 57
F. A. Westbrook visits a Vermont plant that has done it.

Budgeting Plant Equipment Expenditures 61
J. J. Berliner presents a method.

Concrete Under Compressive Stress 66

How Tractors Save Money 67
Charles Geiger discusses this subject.

Hartford Sand and Stone Company Demonstrates Many Economies 70
George Ransom describes a Connecticut plant.

Progress in German Cement Technology 73
An account of the important papers presented at the general meeting of the German Portland Cement Manufacturers in March.

Discussing the Bureau of Public Roads Report of New Jersey Comparative Tests on Crushed Stone and Gravel Concrete 77

Dust Collectors in the Pit and Quarry Field 83

Pit and Quarry Foreign Digest 87

Intimate News of Men and Plants 89

News of Equipment Manufacturers 93

Next Issue May 9, 1928

COMPLETE SERVICE PUBLISHING COMPANY
538 S. Clark St., Chicago, Ill.
Publishers of
PIT AND QUARRY and PIT AND QUARRY HAND BOOK

HARRY W. BAUMGARTNER, President
V. E. LARSEN, Vice-President
S. E. COLE, Eastern Representative
90 West Street, New York
Ph. Rector 4154

HAROLD W. MUNDAY, Editor
GEORGE B. MASSEY, Associate Editor
F. A. WESTBROOK, Associate Editor
E. D. ROBERTS, Associate Editor

ONLY THE BARBER-GREENE HAS THE DISC FEED

Here it is: 1. B-G Loaders are fast. Every bucket takes a heaping measure — and clean-up is clean. 2. B-G repair bills are practically nil.

Here's why: 1. Two flat revolving discs (patented) edge into and under the pile—making sure that each up-coming bucket is filled brimming to the top.

2. The floating boom (patented) rides rough ground—keeping strains and twists away from the loader itself. Wear and tear is slight.

See how others have learned the low down on low loading costs. Ask for our book "Loading Layouts."

THE LOW DOWN ON LOW COSTS

Barber-Greene Company
492 W. Park Avenue, Aurora, Ill.

Disc Feed Barber-Greene LOADERS

Model "25"—1 yard per minute

Model "42"—1¼ yards per minute

Model "28"—wheel mounted

Pit and Quarry

Vol. 16 CHICAGO, ILL., APRIL 25, 1928 No. 2

PUBLISHING TRADE ETHICS AND MARKETNG POLICIES

BETTER understanding can be expected to follow a declaration of policy. Certainly misunderstandings will be fewer. When a declaration of policy concerns trade ethics and marketing policies and is published for distribution among dealers and customers it is time to take notice. We take particular notice at this time because just that has been done by a cement manufacturing company. Commendation is due the International Cement Corporation for taking this stabilizing step. Publicity has been effectively used repeatedly in destroying misunderstandings.

Publication by the International Cement Corporation and its subsidiary companies of a 38-page booklet containing a complete statement of the trade ethics and marketing policies under which Lone Star Cement is sold, marks the beginning of a new era of better understanding between manufacturer, dealer and trade in the Portland Cement Industry.

The booklet is divided into three parts; the first part being a statement of trade ethics, comprised of 31 points observed in the market of its product; the second part of the book is an explanation of the factors and conditions which control the price policy of the International Cement Corporation and its subsidiary companies, and this is followed by a statement entitled, "Twenty-one Reasons for Our Sales Policy."

In making public this booklet, Mr. H. Struckmann, president of the International Cement Corporation, said:

"Misunderstandings grow and flourish in the dark. Turn the full light of publicity onto any situation, and these misunderstandings promptly vanish. To create a full and complete understanding between ourselves as manufacturers of cement on the one hand, and building material dealers, architects, engineers and the public generally on the other, we have just published a comprehensive statement of the marketing policies and grade ethics under which our product is sold. In language that is not susceptible of misinterpretation or dual meaning, we have endeavored to tell how we sell our product, and how we price it, together with the basic reasons for these policies. We are willing to rest our claim to the good-will of the public we serve on the facts as here presented. No attempt has been made at fine writing. Our aim has been to express in the plainest possible English the rules we live by in the daily conduct of our business."

The booklet in part reads as follows:

Lone Star Dealer Policy

"Lone Star cement will be marketed in each community only to or through the recognized and established building material dealer or dealers regularly serving such community. This applies to all classes of buyers except as noted under 'Government and Railroad Business.' Importers, brokers and so-called distributors will be considered as competitors."

Government and Railroad Business

"The United States Government for its own use, railroad (ccommon carriers publishing freight tariffs and recognized as such by State and Interstate Commerce Commissions) for their own use, and State governments which have established a practice of purchasing direct their cement requirements for highway, bridge and other general construction, will be sold direct at the same price and under the same conditions as dealers."

Contractors, Industrial Plants, Etc.

"Contractors, Industrial plants and other purchasers of cement, when buying one or more carload lots, will be quoted direct but only for the account of, or by the written authority of, a recognized established dealer or dealers in the community in which the cement to be purchased is to be used.

"If all dealers in any community refuse to handle an account or if no dealer in the same community has sufficient credit rating to make an acceptable risk on tonnage offered, then we will make direct sale at our list price to any of the classes of trade mentioned under 'Trade Discount'."

Definition and Recognition of a Dealer

"A dealer is a person, firm or corporation regularly engaged in selling Portland cement and other building materials purchased by him for resale; who maintains a stock of such building materials and is properly equipped with other facilities for serving the trade as a regular dealer in his community."

Following is a very clear and concise outline of merchandising policies including such subjects as: Combination Dealer, New Dealers, Prices, Trade Discounts, Terms, Quotations, Contracts, Shipments, Sacks, Routing, Bin Tests, etc., etc.

The second section under the title "Cement Prices" is an explanation of the factors and conditions which control the Price Policy. The last section of the book is devoted to an explanation of the reasons which have prompted the formation and adherence to this dealer policy, and trade ethics.

HIGHWAY EXPENDITURES REACH HUGE PROPORTIONS

MORE than a billion and a half dollars was spent in the United States for road building and maintenance during the fiscal year ended in June, 1925, according to a study just completed by the National Industrial Conference Board. Whereas less than 20 years ago expenditures for roadbuilding were still a negligible item in governmental finance, our present annual road bill amounts to more than one-sixth of the entire public budget, and is exceeded only by our governmental expenditures for education and protection.

The development of the country's roads during the past quarter-century closely reflects the revolution in the field of transportation brought about by the automobile and its rapidly extended adoption as a means of carrying goods as well as passengers. About 1,000,000 miles of highways have been built since 1904, when the total roadway mileage in the United States amounted to 2,151,379, only a small proportion of which was surfaced, traffic consisting principally of short distance market hauling and a few venturesome bicyclists. During the next five years, less than 50,000 additional miles of roadway were built, but between 1909 and 1914 the advent of the automobile made itself felt, 250,000 miles of new roads being added. In the next seven years, although they include the war years when state and local government budgets were held down to the minimum, 500,000 miles of new roads were added.

Perhaps more striking than the increase in total mileage of roadways during this period was the change in the character of the new roads, influenced primarily by the automobile traffic. Winding, often ungraded and rutted, albeit picturesque roads have rapidly been giving way to hard surfaced, wide and straight highways, particularly during the past few years. While in 1904, only slightly over 7 per cent of the total roadway mileage was graded and surfaced, and slightly over 10 per cent by 1914, more than 17 per cent of the much increased total mileage was graded and surfaced in 1925.

The immense volume of long distance motor traffic that has developed during the past ten years, however, also has increased the necessity of a well linked highway system, connecting important centers and fed by the smaller market roads radiating from local centers into surrounding rural territory. It is this phase of highway development which has caused marked changes in the control and financing of road building and maintenance, shifting the burden gradually from the local government to the state and, to an extent, even to the Federal Government. While in 1904, more than 96 per cent or nearly all of the current highway revenue, which then amounted to only $75,965,995, was raised by local governments, who also floated all of the highway bonds issued at that time, the state governments in 1925 had become so active in the field of highway building and maintenance that they raised more than 37 per cent of all highway revenue, while the local governments raised only a little over half of the total. The Federal Government meanwhile had interested itself to the extent of contributing about 10 per cent of the total. Nearly half, or 49.5 per cent of all highway bonds floated in 1925 were issued by state governments.

While the figures cited summarize the development of roadbuilding in the United States as a whole, wide variations in the development in different states and sections of the country are revealed by the board's report. The vast change in transportation methods and road utilization caused by long distance automobile traffic is again strikingly reflected in the great stimulus given to highway construction in the more sparsely settled mountain and western states during the past few years, while the more densely populated eastern states, already well supplied with roads have concentrated more on improving existing roads, even abandoning many older roads made obsolete by the more systematically linked modern highway system demanded in this age of the automobile.

MEN OF THE INDUSTRY

The portraits printed on this page in each number of PIT and QUARRY are taken from our files and their selection is without significance as to current events or as to the position of the individual in the industry.

L. T. Sunderland

Mr. Sunderland is President of the
Ash Grove Lime and Portland Cement Company
of Kansas City, Missouri

EXCELLENT QUARRY BOTTOM SHOT MADE BY AMERICAN CRUSHED ROCK COMPANY

By R. N. Van Winkle

THERE are two good reasons why something should be written about the bottom shot at the White Sulphur, Ohio plant of the American Crushed Rock Company on March 24th. First, it was a bottom shot in an open pit quarry and was made to open up and develop a lower working level, which in the vernacular of the quarry man is called sinking. Second, it was a clear demonstration that with a properly mapped out course of procedure coupled with modern day science that even the operation of sinking or going deeper in a quarry can be accomplished with accurate results.

With present day scientifically manufactured explosives and quarry engineering talent the blasting or shooting in a modern quarry is not the hazardous and uncertain task it was a few years ago. Today to my notion it is approximately 90 per cent knowing how and what to do and 10 per cent in really doing it. Successful forethought and preparation nine times out of ten are producers of successful results.

Radical changes have been wrought even in the quarry industry by modern day science even if we do not realize it. Modern explosives, improved machinery, and engineering are all products of science and the quarry man who for one minute believes he can afford to do without any one of the three is unquestionably not going to succeed and progress. While the writer has always been, for years past, the champion of the engineer and scientific methods in the quarry industry, he is frank to admit that the planning, execution and results obtained from the blast which will be described in detail later, was a new stimulant to his imagination as to the possibilities of scientific methods in quarrying operation. Moreover the possibilities of the use of explosives are just beginning to be realized and this goes for the quarry industry too, for the quarry man or the quarry operator who thinks he has his blasting or shooting problems solved and is satisfied to rest on his oars will soon be badly fooled.

Bank shooting and shooting up the floor of a quarry preparatory to sinking are too entirely different problems, even in the same quarry, and the latter is by far the harder to handle with satisfactory results as you are working more or less in the dark. In our particular case it was only after considerable figuring that it was decided to make the first or opening shot in this lower level as large a one as practical for many reasons, better breakage, larger area in which to use a steam shovel, and etc. So finally when the shot was made it embraced 384 well drill holes loaded with approximately 44,000 pounds or 22 tons of explosives and was quite likely the biggest single bottom shot ever made in Ohio which state is the real home of big quarrying operations.

No man, quarry man or layman, who could have stood with me on the quarry bank and witnessed the blast or shot described in this article could have failed to have been thrilled by the sight. While science again plays a big part in making it possible to obtain photographs of this shot or blast which are reproduced here, no picture can do justice to such a spectacle, conceived and actually controlled by human hands with the aid of modern science of explosives.

In a present day major blast or shot in a modern quarry, the rule of thumb methods of a few years ago are supplanted by engineering principles and

Bottom Shot Made by American Crushed Rock Company at White Sulphur, Ohio, March 24, 1928.

LeRoy Keane Planned and Supervised the Blast

the scientific handling and placing of explosive charges. In this particular shot preparations were begun 4 months prior to making the shot. Levels were run to pre-determine the depths of well drill holes, profiles made to take care of future drainage on the new quarry floor, and a plat made of the entire shot. This plat showed each hole located to scale, each hole was numbered for future reference when loading with explosives and on this plat the elevation of each drill hole was given as a guide to drillers and again as a guide to the shooter when loading that particular hole with dynamite. It was found after drilling the entire shot that it was impractical for many reasons to drill each hole in the exact location as originally planned.

The plat above referred to was corrected and each and every hole was located to scale. Particular emphasis is given this question because it will often be found and it was true in this case that by referring to the corrected or revised plat it will be very evident that in many instances your drill holes are too far apart and that extra holes must be put in to assure good fragramentation and breakage. These extra holes are immediately entered on the plat and are given the same number as the nearest hole plus a letter, such as 13-A or 129-B. This plat or plan as it might rightly be termed is almost indespensible for accurate work and is a guide for drillers, shooters, also a guide in ordering explosives, the placing of exact explosives charges at each and every hole to expedite loading and last but by far not the least is the basis for computing the blast or shot to determine the tons shot per pound of explosive, tons shot per foot of drill hole, and the cost of same which are absolutely essential if we are going to attempt to improve or progress in the scientific handling and use of explosives. In this particular instance it appears only reasonable to me that the user or consumer of explosives should co-operate with the manufacturer in obtaining all the data and scientific information possible regarding action, results and behavior of explosives under actual field usage as undoubtedly this information would be useful in the laboratory of the manufacturer and ultimately would be beneficial to the consumer and manufacturer alike in assisting in laying a better foundation for the manufacture and uses of commercial explosives.

A detailed description of this shot is as follows.

Results of the Bottom Shot

Russell Scott, Engineer for American Crushed Rock Company

Dave Water and Jim Jerrell Are the Boys Who Really Loaded the Blast and Lighted the Fuse

It consisted of 6 lines of well drill holes which finished 6 inches in diameter, a 5⅝ inch drill bit being used. These holes were placed as near as possible ten feet apart, naturally there was some variation but 10 feet was the maximum. The holes were somewhat rough, casing being required in many instances. All holes were full of water when loaded and in many cases eight or ten inches of water stood on the level over the drill holes. This excessive water in the quarry was due to spring thaws and due to this water condition the actual loading was slow and tedious.

Three days' actual time was consumed in loading this shot as men worked in rubber boots and were quickly wet through and through with water from the tamping poles.

Well drill holes were drilled from 26 to 30 feet in depth and averaged 28 feet throughout the entire shot. This variation in depth was necessary to attempt to make the floor or bottom of the new cut on a ½ of 1 per cent grade for future drainage purposes. When drilling, a log was kept of the holes drilled and it was discovered from this log that from 14 to 15 feet from the top of the present quarry floor a small seam was encountered and this fact is mentioned here as it had a direct bearing on the loading of these holes and will be later referred to.

In selecting the explosives it was decided to use Ammonia Gelatin L. F. 60 per cent and 40 per cent in the following sized cartridges, 5x12—5x16 and 5x24, and it required 2 cars of these sizes and strength to dynamite for the shot. A typical hole loading was 116⅔ pounds total, 100 pounds of 60 per cent in the main charge which loaded about 8 feet high, then 8 feet of stemming, then 16⅔ pounds of 40 per cent in the deck load and approximately 11 feet more of stemming. The charge was broken to take care of the seam referred to in the foregoing paragraph.

The method of detonating the entire shot was with Cordeau Fuse and cap. Over 12,000 foot of countered cordeau was used in the holes and 4,000 feet of plain was used as leads to connect up the holes making a total of 16,000 feet used for the 384 holes which comprised the entire shot.

With the aid of the plat or plan of the shot referred to above it was an easy matter to compute the results after the shot was made and it is such results that are so absolutely essential to really know what you have accomplished besides being indispensable in planning future shots. The solid cubic yards of stone broken was 38,538. Tons broken was 86,720. Pounds of explosives per solid cubic yard 1.06. Tons broken per pound of explosives 2.07. Tons of broken stone per foot of drill hole 8.06.

Aside from the water encountered and adverse weather conditions while loading the shot, everything moved along according to plan and schedule and from all indications the desired results were obtained. Still when one goes over the completed shot checking results and looking for signs either good or bad he cannot avoid marveling at the stupendousness of the modern scientific explosive. It is near miraculous how man's ability to actually

control these forces has developed so that today we through scientific knowledge can make such tremendous forces act to our will and bidding in about as positive a manner as steam and electricity are controlled.

To any reader who is familiar with my activities in the quarry industry and my past articles on quarry matters it would be foolish for me to deny my having anything to do with this shot. The part played by me was very small and of no importance but it is a pleasure for me to accompany this article with the photographs of the two men who actually planned and supervised the shot. The major portion of this credit is due to my friend of many years standing, Mr. Leroy Keane of The Hercules Powder Company and as an understudy he had Russell Scott, Engineer of The American Crushed Rock Company at which quarry the shot was made.

Even we who are accustomed in our daily routine to the handling and use of explosives are inspired or, should be once in a while, to reflect for a moment at least as to what present day explosives, their manufacture and application means to the quarry industry or mankind. Space does not permit enumerating or even attempting to enumerate all of them so just let us take the quarry industry. It can be said and truthfully that the manufacture and application of explosives has been the real foundation of our industry as we know it today. Without explosives quarries would be rare in this day and age. We are now able to do with modern explosives in a remarkably short space of time the work of hundreds or thousands of men and if we were compelled to obtain the same results with man labor, it would mean nothing short of physical bondage and human slavery to the men so employed, such as was had in the olden quarry age. Bondage and slavery are not comfortable or interesting things to even think about in this mechanical age of ours, so while our lot in the quarry industry may at times look tough and blue just remember we could be worse off if we did not have explosives.

Standard Building Units*

By C. L. Bourne and J. F. Winkler

This report covers a preliminary investigation of methods of tamping and feeding employed in the manufacture of dry tamped concrete units, for which concrete block was selected as the most representative.

The test included two gradings of aggregates, two consistencies, four methods of feeding and four numbers of tamps, including 12 variables combined to give 56 different conditions. Pea gravel was combined with torpedo sand, giving a fineness modulus of 4.23; torpedo sand with a fineness modulus of 3.23 was used in the second group. The concrete was of dry consistency, containing sufficient water to produce blocks with slight web markings; concrete of wet consistency, containing sufficient water to produce blocks with very pronounced, running web marks. It was fed into the mold in one, two, three and four layers. The total tamps included 6, 12, 18 and 24 strokes of each of four full tamping feet working alternately. The sand, fineness modulus 3.73, and gravel, fineness modulus 5.55, used in group 1, were combined in the proportion of 73 and 27 per cent by volume, respectively. One cubic foot of cement was used with 7.35 cubic feet of dry rodded aggregate. Wet and dry consistencies were judged by three plant operators and the engineers in charge.

The water for each batch was weighed on a 50 pound scale and the same quantity was used for each condition. The specimens were made at the plant of the Elmhurst Chicago Stone Company under regular operating conditions. Sand used in group I was taken from the storage bin at the plant; the gravel for group I and sand for group II were purchased from a local dealer; all aggregates were of good quality, and Portland cement from the same carload was used.

The concrete in each batch was mixed dry 1½ minutes and 3 minutes after adding the water. It was fed into the mold in one, two, three or four layers according to the requirements of the tests. The block machine was a standard vertical stripper with four full width mechanical tamping feet, making one standard 8 by 8 by 16 block with three oval cores. Each tamper weighed 66½ pounds and dropped 11 inches and was run by the regular operator who deviated from ordinary practcie only by introducing the variables. The average size of the 15 blocks was 8 by 7¼ by 15¾, giving a gross area of 126 square inches.

The conclusions on the effect of different methods of tamping may be called tendencies for the actual difference in strength is not sufficient to warrant definite deductions. In general, 18 tamps produced the stronger blocks for which the strength ranged from 676 to 1290 pounds per square inch while for 12 tamps the range was from 599 to 1227 pounds and for 6 tamps it was from 555 to 1,111 pounds. Further investigations will be made to determine the effects of variations by changing the weight, the length of stroke or sequence of blows.

Concrete fed in one or two layers had approximately the same strength and those fed in three and four layers gave about equal strength. By increasing the number of tamps in one or two layers resulted in little increase in strength while in those of three or four layers, noticeable increases resulted.

*Abstract of report presented to the Twenty-fourth Annual Convention of the American Concrete Institute.

SALVAGING STONE AND GRAVEL ROADS WITH ASPHALTIC SURFACES

By Wm. H. Rhodes
Southern Branch Manager The Asphalt Association

HERE in the Southwest the officials of the towns, cities and states are confronted with a situation or condition which we believe is an old story to many of you, regardless of where you are from. The problem is right at our doors and must be met and solved without much further delay. It is how to improve the temporary surfacings we now have so that they will adequately serve the traffic with the least possible expenditure.

During the past twenty years or more we have witnessed and assisted in the construction annually of many miles of gravel or broken stone roads and streets. With the states this policy has been more closely followed perhaps than in the cities but we have many hundreds of towns where the only form of surfacing is either gravel or broken stone. In the Louisiana State Highway System only approximately 2 per cent of the total mileage has been paved although the entire remaining 98 per cent has a surfacing of gravel or shell. In Mississippi, the policy has been to lay gravel as far as possible. This year less than 30 miles of paving was let by the State Highway Department although they had a very extensive gravel program. In Arkansas a few pavements were laid in the past but nearly 90 per cent were gravel. In Texas the conditions are very similar although Texas has probably made the greatest progress in the south towards connecting the larger cities with high type pavements.

A like condition prevails in the small cities and towns. The towns have first patched the worst mud holes with gravel and rock. This early repairing of the dirt streets was so successful that somebody conceived the idea of covering all the business streets with gravel or rock. At first a thin layer was spread but it soon developed holes which had to be filled. This patching and repairing is still going on. It is a continuous operation. In addition, new streets are being graveled, hundreds of them every week, until I believe I am conservative when I say that in our small towns at least 90 per cent of the surfacing is gravel, shell, or rock.

I am not making any criticism of such procedure. It is probably the very best thing to do in most of the communities but I do believe that many of us engineers have been lax in pointing out to the city and state officials just what will happen to our roads and streets under modern traffic, and what steps may be taken later on to better the surfaces as travel demands.

From experience gained in maintaining the highways in Louisiana and Oklahoma I know that a road carrying 600 vehicles per 24 hours will in five years wear down a gravel road laid 8 inches thick to a veneer of less than 3 inches. The 8 inches of gravel laid loose will compact under traffic to about 6 inches. It is a very conservative estimate to say that the gravel surface will wear away at least ¾ inch per year. I made many tests and investigations which established this fact. In small towns and cities it is very seldom the case that the gravel does not wear away twice as rapidly as on the highway due to much heavier traffic, and in addition, the very disastrous effects on the gravel of sprinkling with water, in order to lay the dust. If any of you have had experience in trying to maintain a smooth surface on a gravel street which is sprinkled twice a day you can realize the damage done. Assuming that 1½ inches of gravel wears away a year the town suffers a loss of one-fourth of its surfacing annually. In this part of the country 6 inches of compacted gravel costs in place from 50 to 75 cents per square yard. So it is evident that the town is losing in gravel the value of from 13 to 18 cents per square yard per year. This fact should be carried in mind because it is one of the important factors that determine the practical reasons for improving the surface with a better type.

The other reasons for improving a gravel or rock street are either physical or esthetic. A gravel street is nearly always rough to ride over. It requires constant blading or dragging. The streets are always dusty except during a rain, and even then the mud is worse on your car than the dust. All of us who drive much know that in summer nearly all of our colds come from dust. And punctures! Who hasn't condemned rock and gravel surfaces for this cause alone?

The efficiency expert employed by a tri-state bus company operating in this territory wrote a country engineer not long ago that the cost of tires on their heavy buses running over the loose gravel road between Shreveport and Monroe, Louisiana, was 2 cents a mile more than the cost on tires on the buses running over the asphalt road between Shreveport and Greenwood. A conservative saving in the wear on the tires of an average car would be at least 0.6 cent per mile. Most small town streets, other than residential, carry at least

*Paper presented before the Annual meeting of the American Society for Municipal Improvements, Dallas, Texas, November, 1927.

1,000 cars per day. Should the gravel road be treated or surfaced the daily saving would be $6 per day or $2,190 per year per mile. Of course, these savings are to the individual and are therefore not as evident to the community as the other advantages. The beauty of an asphalt street is also very desirable. It tones up the neighborhood.

All of these reasons for improving our gravel and macadam roads are encountered in nearly every town. Our duties as engineers are to explain to the officials the various methods that can be followed in making the improvements, at the same time explaining the good or bad features of each type. If the city officials and the taxpayers understand the probable costs, and probable life of the improvements, there will be many less disgruntled property owners to placate later on.

Asphalt surfacing lends itself to many methods of construction. It can be adapted to meet any amount of traffic or type of traffic. The purpose of this paper is to briefly mention a few of the standard methods of design and construction that may be followed to improve a gravel or broken stone road.

These various steps in betterment are as follows:

1. Surface treatment.
   - A. With cold asphaltic road oil.
   - B. With hot asphaltic road oil.
2. Asphaltic macadam (penetration).
3. Asphaltic concrete.
4. Sheet asphalt.

1. Surface Treatment

A. With cold liquid asphalt. The purpose of such a treatment would be to lay the dust and secure penetration of the gravel, the treatment acting as a binder course for a later treatment of hot oil. The principal advantages of this method are that the oil does not require a heating plant at the car nor a pressure distributor to spread it on the road. The disadvantages are that it does not form a mat or smooth surface and is of only temporary value if neglected. The oil coats each pebble with a film of asphalt and penetrates the surfacing to a depth of from one to two inches. In Oklahoma we found that this treatment materially aided the stability of the gravel surface, it laid the dust, and, as stated above, made an ideal first treatment to be followed later by a hot oil application. We used an oil containing about 60 per cent asphalt and spread at the rate of 0.5 gallon per square yard.

The procedure was to first patch any depressions in the existing gravel surface using, if possible, as patching material the same kind of which the road was originally built. Then the surface was thoroughly bladed and shaped to the desired cross-section using a heavy road machine. Traffic was allowed to use the road for several days so as to thoroughly compact the patches. Then the gravel was reshaped and the oil spread. Traffic was kept off for 24 hours. After a few months of wear I would recommend that the treatment be followed by a hot application. Best results will be had from the cold oil treatment on sand gravels where the oil will penetrate. On closely bonded clay gravels I would not recommend cold oil treatments.

B. With Hot Road Oil. This is the so-called carpet treatment that is very generally followed both in towns and on county highways where it is desired to lay the dust, make a smooth waterproof surface, and conserve the gravel. If especial care is taken this treatment gives very excellent results and the cost is not excessive. It should be generally understood, however, by all concerned that in no sense should it be classed as a pavement. Wherever weak places develop in the gravel subgrade depressions will appear in the surface requiring prompt maintenance.

Before attempting any treatments or improvements it will be well to thoroughly test the gravel or rock street as to thickness. It is a waste of time and money to attempt to treat a thoroughly worn out surfacing. The success of this oiling depends on a substantial base, firm enough to hold up under traffic provided the covering is waterproof. As all of you know a gravel street when saturated is in its least stable condition but if it can be kept dry by waterproofing a somewhat less thickness of compacted gravel can be used than would be needed to hold traffic without such treatment. Should your tests show your gravel streets are thin they can be brought to the desired thickness with additional gravel and permitted to consolidate under traffic.

The asphaltic oil now used most generally is of from 175 to 250 penetration although many states still demand the old 80 per cent road oil. These oils require heating to be withdrawn from the tank cars and require pressure distributors for spreading. The oil works best when heated to about 275 degrees Fahr.

After the street has been carefully patched, brought to true sub-grade cross-section and compacted by traffic we then are ready to apply the oil. The street should be closed to traffic. First, with a rotary broom sweep all the dust, dirt or loose gravel to the gutters or ditches. In case of a macadam road any crusts of dirt or dust should be broken off and the surface swept clean. After sweeping, the pebbles or rock should be left protruding somewhat so as to better give a hold to which the oil can cling. Then the asphaltic oil is spread with the distributor at the rate of about 0.5 gallons per square yard. On this is cast the cover material which is usually washed pea gravel or clean rock chips none of which are over ¾ inch. A fair estimate of cover material is that one cubic yard will cover about 70 yards or about 40 pounds of rock will be needed to the square yard of treatment. The spreading of the rock is usually done from piles previously spread along the street on

the sides, the piles closely placed so that the shovelers can easily cast. Several contractors state they have used mechanical spreaders with success but I have never been able to do so. This method of treatment is probably the cheapest and simplest of all surface treatments. The excellence of the results will depend largely upon the uniformity of spread by the distributor operators. Should it be necessary to stop to clean the nozzles of the machine, or for other causes the machine stops, the oil should be cut off promptly. Otherwise there will be a "fat" place or bump where the asphalt dripped and puddled.

Sometimes where additional thickness of surface is necessary we have applied a second coat following exactly the same procedure as the above. This is not usually to be recommended however, as such a mat under traffic may become uneven and break. The great tendency in this work is to get the mixture too "fat," that is, with the asphalt content too great throughout adding enough covering material. You should keep the oil thoroughly covered and as the black begins to show through the loose material on top, add more until all of the oil has been taken up.

Another manner of preserving gravel surfaces is the so-called inverted penetration method. This has been used extensively in Texas. The method is somewhat the same as the surface treatment, except that the covering material is much larger rock or pebbles. More asphalt is used, probably about ¾ gallon per cubic yard. The first course is thoroughly rolled after the rock has been added and a second application of asphalt is made of about one quarter gallon per square yard. Fine material is then used to seal tight the surface voids. This inverted penetration method is an adaption of the asphalt macadam, or penetration method.

There are many other methods followed by various engineers and state highway departments with slight changing of the several operations. With the single hot oil treatment the asphaltic mixture will be about one-half inch. With the cold oil treatment followed by the hot oil treatment a mixture of at least 1 inch and possibly up to 2 inches will be had. These treatments can be classed as temporary and are to be used more or less as a stop gap while efforts are made to bring out a program of paving. They are first steps toward progressive construction.

2. Asphalt Macadam (Penetration)

With the exception of Louisiana and Mississippi most states in this section have an abundance of rock suitable for street construction and consequently we find many towns where water bound macadam streets have been built and been in service for many years. With the heavy wear of modern traffic the macadam surface has become so worn out and ravelled that some steps should be taken to secure either a new pavement or so treat the existing macadam as to provide a new surface. The simplest manner of providing a new asphaltic wearing surface is by the penetration method.

Public officials are always faced with the necessity of conserving funds. Few engineers have an unlimited treasury they can dip into for their street programs. They must build a pavement adequate for the traffic and yet the cost of which will be within their means. Penetration surface probably exceeds any other type of asphalt surfacing on the highways throughout the country. In the state of Texas there is a very great yardage. In all of the older states, in New England, in Pennsylvania, West Virginia, Kentucky they have for many years been doing just what we are recommending here, that is, reclaiming or salvaging the old macadam streets and roads with asphaltic macadam. They have bought these new pavements very cheaply. Cheaper than they could have purchased any other kind.

This method is to be recommended where suitable rock is inexpensive and where the old macadam street can be used as a base, where funds for the improvement will permit asphaltic concrete should be recommended in preference to penetration macadam as the superiority of hot mix pavement over a penetration macadam is marked.

There are many considerations in using the old road as a base. There is the question of thickness of the old macadam, of the elevation of the center and also the crown and cross-section. Also the question of curbs or headers.

The thickness of the old macadam must be enough to act as a base for the new pavement. Of course many engineers reason that if the road before improvement was strong enough to carry the traffic it surely will be ample when a surfacing is added. This opinion will be true more often than not but you should bear in mind that a new street always attracts more traffic and heavier loaded traffic. That is a problem each city or state engineer must solve for himself from his own experience in the city concerned. It is not possible to say what should be the minimum thickness. That depends on the sub-soil conditions and the type of traffic but I do not believe that under any conditions it should be less than 5 inches. In salvaging the old macadams in Nashville, Tennessee, I believe 8 inches is the minimum and the surfacing is laid directly on the base.

Where the thickness of the base is not enough, additional rock may be added. This can be done by lightly scarifying the old surface and adding the necessary rock before thoroughly rolling.

In many cities the center elevation of the street is too high to permit the adding of the pavement without cutting. As previously mentioned in the first part of this paper most of our streets have

been macadamized or gravelled by piling up the material in the middle of the street. Usually this has given a very high crown and the top of the roadway is excessively rounded. Where this is the case, and the thickness of the material at the center permits, the center should be scarified and the excess either used in building up the quarter points or the sides. Of course, if the curb and gutter is already in, as I find is usually the case, it may be necessary to either tear the curb and gutter out to establish a new grade, or else remove and lower the old macadam. Where the latter course is necessary the value of saving the old macadam for a base still remains as it would still be as necessary to remove the rock and excavate should any other pavement be laid. The cost or value of the rock would be saved.

In cities a curb or header has been found necessary. This is due to the nature of the traffic which is constantly turning off the pavement or mounting up on the pavement from the gutters or ditches. Usually this header or gutter is of concrete. To the contrary on country roads and parkways I do not believe concrete curbs or headers are necessary. There the traffic follows more along the line of the pavement. There is very little running on and off as in a city. The only advantage a concrete header gives is to help brace the edge of the pavement to withstand the weight of traffic. Traffic on country roads divides, each vehicle stays on its own side and as a consequence the wheels pass over the same narrow lanes of pavement. In Oklahoma we found that traffic uses a lane about two feet wide for each wheel and that the center of that line is about 18 inches from the edge of the pavements. Heavily loaded trucks hug the edge more closely than other vehicles. Their loads are usually bulky and by crowding the edge passing traffic has more room. Such concentration of loading on the edge of the pavement naturally has a tendency to rut, and also to shove out. All of us have seen this very thing happen, and it happened with roads having headers as well as those without. To overcome this weakness modern practice has adopted the thickened edge for asphalt surfacing on gravel or macadam bases where such thickening is practicable. This increased thickness, or inverted curb, as it has been named, has been very successful. In Oklahoma we had several miles of asphaltic concrete laid on an old gravel road bed without curbs. The extra binder required to bring the cross-section of the old gravel road to the proper design for an asphalt surface was enough added thickness to support all traffic. There was almost no pushing out. The same condition holds on the experimental road built by the Louisiana Highway Commission. The old gravel road was widened to 18 ft. by two strips of asphaltic concrete. This thickened edge has held the traffic with almost no depressions. In Caddo Parish, La., where macadam bases are the standard, no curbs are now used and yet the surfaces carry very heavy oil field traffic without serious defects appearing.

The greatest objections to concrete headers is their great cost. Rarely can they be built for less than $5,000 per mile. At 4 per cent interest this sum would give $200 per mile which I feel sure you will agree would patch a lot of pavement. I am convinced that concrete headers are not necessary but I am also of the opinion that it is very good practice to leave the wooden form boards in place. To do so costs very little and the boards will remain for several years, long enough to permit the thorough compaction of the shoulders, meanwhile giving additional support to the pavement.

I do not infer as part of this paper that I should go into details as to what constitutes asphaltic macadam or hot plant mix pavements, their manufacture or research investigation pertaining to them. That would require too much time. It might be well, however, for me to very briefly outline the general standard method of laying a penetration macadam surface course on a macadam base as described before. The customary thickness desired is about 2½ inches.

The aggregate may consist of crushed rock or slag of proper toughness and density. The sizes of the stone should be graded from 2½ inches down to ¼ inch and should be separated into three sizes. The coarse stone being from 2½ inches to 1 inch, the medium size stone from 1¼ inches to ¾ inch and the fine stone for the seal coat ranges in size from ¾ inch to ¼ inch. In grading the aggregate the greater portion of each classification should be of the larger sizes.

The asphalt used should usually have a penetration of from 60 to 120, according to the nature of the traffic and the ranges in temperature where used. I believe that in the past the practice has been to use asphalt cement having too high penetration and as a consequence in high temperature the surfacing became softer than it should. Georgia, for instance, has been specifying 60 to 80 penetration asphalt and their new specifications set the limits at 60 to 70. I have heard several criticisms along these lines in Texas especially where the sun gets pretty hot in summer. The method of construction is briefly as follows:

On the prepared base the coarse rock is spread to a uniform depth of 2½ inches, care being taken that there are no dirt pockets. This course is then thoroughly rolled with a 10-ton roller until the stones are tight enough to permit a truck to pass over without forming deep ruts.

On this first course the hot asphalt cement is spread using a pressure distributor and applied at the rate of about 1.6 gallons per square yard. Extreme care should be taken to secure a uniform

distributor. In case a pressure distributor is not available hand pouring pots are used.

While the asphalt cement is still hot a thin uniform layer of the medium size stone is cast over the road so as to completely cover the asphalt and sufficiently fill all voids. This course is then rolled thoroughy until as much of the stone as possible has been worked down into all the openings in the larger stone.

The surplus stone is then broomed off and another application of hot asphalt cement made at rate of ½ to ¾ gallon per square yard. On this is spread the dry fine rock and the road again thoroughly rolled. The finished road should be absolutely free from ruts or any depressions.

A penetration macadam built carefully as above described on an adequate macadam base will make a very satisfactory pavement at a reasonable cost per square yard.

3. Asphaltic Concrete

The use of asphaltic concrete in reclaiming macadam roads is very general and where funds will permit this method should be followed. The advantages of hot mix over penetration are many. The relative merits of Fine Aggregate or Coarse Aggregate asphaltic concrete will not be touched in this paper. Most of you are familiar with them. In asphaltic concrete with its properly graded aggregates we get a dense mixture and a uniformly mixed pavement from a hot mix asphalt plant. Such surfaces are among the best in the world as to long life, low maintenance cost and smoothness.

The great future of asphaltic concrete in this section of the country lies in the reclaiming of our gravel roads and streets. We have thousands of miles of such highways, on the main trunk lines that are very rapidly wearing away. It is also true in our cities and towns. More and more the city officials are beginning to realize that on many of their streets, especially in the residential sections and in parks, it would be a very reckless waste of funds to tear up and throw away the existing gravel base in order to substitue one of a very expensive type. The gravel base will probably be strong enough and what a saving is made! The engineer must carefully test and examine the gravel before he makes his decisions. In this section we have several cities which have used this type of construction almost throughout the entire town. On a few streets where there is heavy hauling a concrete base has been laid but on all the side streets asphaltic concrete is used. Several of the most beautiful drives in the south are of asphaltic concrete on gravel. The boulevard along the Mississippi Gulf Coast is nearly all asphaltic concrete on gravel. Riverside Drive in Monroe, La., is of the same type. Both have given perfect satisfaction. The whole proposition comes back to the question of the base. If the base found is strong enough by all means use it.

The manufacture of asphaltic concrete and the methods of spreading, raking and rolling I will pass over through lack of time.

This type of pavement is especially adapted to communities where there is an abundance of gravel, and where gravel is cheap. Asphaltic concrete with gravel aggregate, on a gravel base, are very commonly used together.

Usually where we find a majority of the streets or roads in a community have been built of gravel instead of rock it means that gravel in that locality is much cheaper than rock, and because of these conditions we find gravel roads reclaimed or surfaced with asphaltic concrete.

The procedure followed in shaping the old gravel bases is very similar to that described for macadam bases. The thickness of the base however probably should be more than 5 inches where traffic might be heavy. Satisfactory results have been had where the gravel was 6 inches compacted.

In case the old gravel road is not thick enough to be used as a base the laying of a binder course or black base is now very generally adopted and followed. For strength it is more or less a general practice to consider one inch of black base the equivalent or better, of two inches of compacted gravel. Testing of the depth of the old gravel street is necessary and with this knowledge the engineer can design the base so as to give the required strength to support the top course of asphaltic concrete using the gravel base supplemented with the black base. Asphaltic concrete surfacing is generally laid 2 inches thick.

4. Sheet Asphalt

The procedure followed in reclaiming old gravel or macadam pavements when sheet asphalt is used as a surfacing course is very similar to that outlined above for penetration macadam and asphaltic concrete. Especially so with reference to the shaping of the old road, patching and preparation of the base and making ready for the surfacing course.

Sheet asphalt is usually laid with a binder course, although this may be dispensed with if the foundation is a black base. Several of the southeastern states are now reclaiming their worn out gravel road by topping the old road with a 3 inch binder course on which is spread a sheet asphalt wearing surface 1½ inches thick. These roads are giving very excellent results.

In this connection I wish to warn against using a closed binder. A more or less open binder must be used, especially where gravel is used as coarse aggregate. The percenatge of sand should be cut to a point where the surface texture of the compacted binder is distinctly rough, or otherwise slippage of the wearing course on the binder may

occur under traffic. I have been told that last year the State Highway Department of Michigan experienced considerable trouble along this line in connection with the use of binder or black base course under fine aggregate asphaltic concrete and the trouble has been remedied by cutting the percentage of sand used in the mix.

The merits of sheet asphalt are very well understood by nearly all engineers. It makes an ideal city pavement due to its long life, its cleanliness and the ease with which it may be repaired, its resiliency, and its very pleasing appearance. With very few exceptions sheet asphalt predominates as the type of pavement in the larger cities of the country. City engineers have shown that they also agree with this opinion by their almost unanimous recommendations for paving programs.

Sheet asphalt has also been very successfully used in resurfacing brick and granite block pavements. The usual procedure has been to true up the unevenness of the brick surface with a binder before laying the topping. Where there are car tracks a few rows of brick adjacent to the tracks are removed. Also two or three rows of brick are taken up along the gutter. With the binder the desired shape or cross-section of the base is then secured at the edges which will permit the molding of the sheet surface to fit the gutter and the car tracks. In this section of the country we have several very excellent examples of such resurfacing of old brick streets with sheet asphalt. The easy rise at the gutter line fitting the gutter edge to the surfacing is not objectionable and does not seem to be noticed. A very notable example of just such resurfacing is near here at Texarkana, and if any of you are contemplating such work in your own cities it will pay you to stop off there.

Summary

This paper has not gone into the processes of manufacture of the various types of asphaltic paving mixtures with the discussion of research investigation. To have done so would have required much more time. I have made an effort therefore to outline to you, first the fact that in this southwestern country, especially our gravel and macadam streets and highways are very rapidly wearing out due to the entirely unforeseen tremendous increase in traffic. To replace the gravel or rock worn away annually would require extremely high maintenance expenditures, far in excess of the benefit derived. As an economic proposition it is possible to improve these types, to salvage their present value, using them as a base for an improved type of pavement which if properly designed and carefully constructed will give the cheapest and yet the best type of surfacing possible to secure.

It is believed this will apply to highway construction in any part of the country.

Cotton in Highways

During annual textile week celebrated by the Textile school of North Carolina State College E. C. Morse of the Cotton Textile Institute made some interesting observations concerning the use of cotton in highway construction.

An interesting use of cotton in highway construction is that made by a State Highway Engineer, in Newberry County, S. C., who has used a fabric on a road having light traffic and where the cost of ordinary asphalt or concrete paving is prohibitive. He first poured a prime coat of light tar, then spread over it the next day an open weave cotton fabric which in turn was covered with hot asphalt and then with a coarse sand. After nearly a year's use, this proved highway shows very little, if any wear. The significance of this use is apparent when we recall that there are 2,485,000 miles of unimproved rural roads in this country.

Still another interesting use of cotton in connection with road construction is a fabric which has been developed at the request of a highway engineer under the supervision of the textile engineer and research associate at the Bureau of Standards of the Cotton Textile Institute, Inc., known as a cleavage fabric. This fabric is laid on top of the base course of a concrete road before the finished course is poured. When repairs to the road are necessary due to wear or other reasons, it is claimed that the finished or top course can be easily split off and separated from the base course due to the insertion of this fabric and a new top course put on, making the road as good as new.

Flotation of High Silica Bauxite

Laboratory flotation tests on high silica bauxites made by the United States Bureau of Mines, Department of Commerce, at its Southern Experiment Station, Tuscaloosa, Alabama, have given results which compare favorably with results of earlier fractionations made by means of heavy solutions.

Indications are that the laboratory flotation machine can be depended on to give a good separation between the clay and the bauxite provided that these two constituents have been sufficiently liberated from each other by crushing, and provided that the crushing has not produced an excessive amount of slimes. The principal reagents used consist of sodium sulfide and oleic acid. Recent tests indicate that only a comparatively small amount of these reagents is required for the flotation of the hydrous aluminum oxide minerals. One sample of bauxite recently experimented with showed that an amount of sodium sulfide equivalent to five pounds per ton of ore was sufficient to give a well sulfidized pulp. Flotation tests of high-silica bauxite are now being made in 500-gram machines and it is hoped that it will be possible to duplicate the results that have already been obtained with a 50-gram machine.

INCREASING PRODUCTION PER MAN

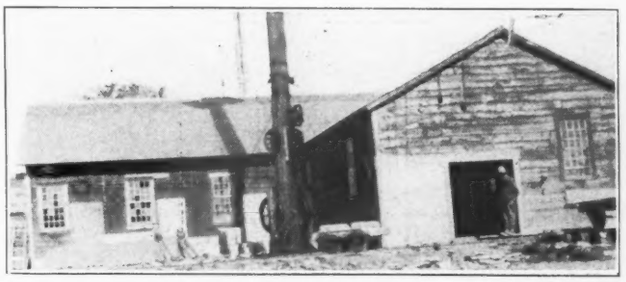
By F. A. Westbrook

THE slate industry is not behind most other progressive industries in taking steps to make its processes more efficient. At least this is true of some of the operators and it would seem that in these times of keen competition and high cost of everything including wages it is a case of improving efficiency or going out of business.

One of the most interesting cases of this sort which anybody could wish to find is at the roofing slate mill of S. Allen's Sons, Fair Haven, Vt. This mill is at the Eureka quarry described in the March 15, 1926 issue of Pit and Quarry. By a simple rearrangement of floor space, the abolition of a few "time honored" traditions and the introduction of certain new procedures the output of the mill has been increased about 45 per cent without increasing the number of men employed. Somebody had a big idea and it worked. Whether anybody could make it work is not known but it seems probable. At any rate the superintendent is Mr. R. Temple Jones. It is certainly interesting to be shown around by him.

Formerly, in the mill a group consisting of a sawyer, splitters and trimmers worked together as a unit. They carried out their own finished slate, cleaned up and did work other than produce slate. Much time was thus wasted and there was always the problem of the different men in each unit keeping up with each other and the liability to inefficiency was directly proportional to the number of units.

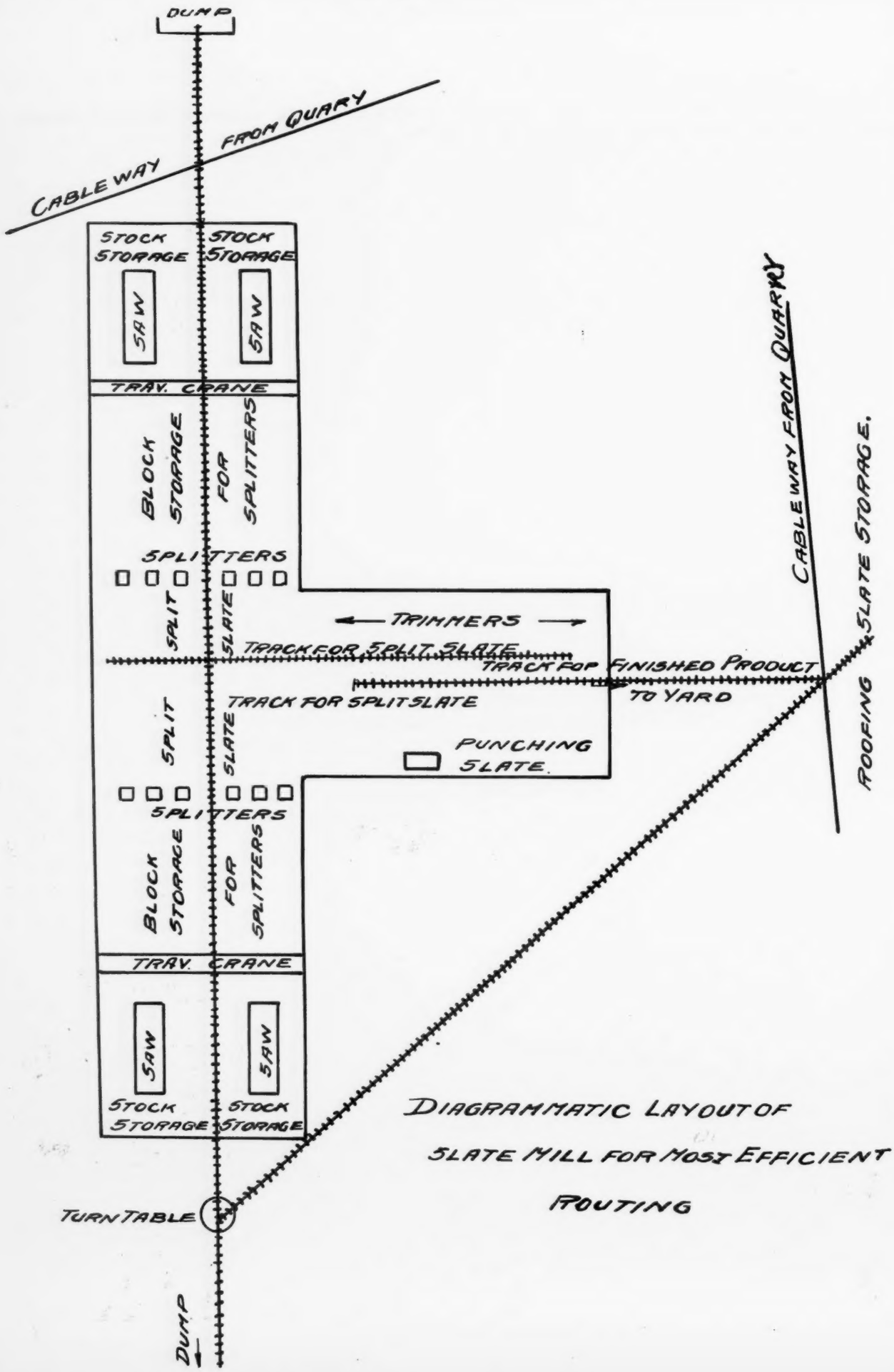
By the new arrangement the mill has been divided into departments. The sawyers, splitters and trimmers work as separate units and the work of bringing quarry stone, carrying out finished material and clearing away trimmings is done by men especially assigned to such work. Thus everybody is busy all the time and the slate is kept moving. Just how this is accomplished may be seen by reference to the flow plan of the mill.



View of Plant Showing End of Trimming Shop

Quarry stone comes in at each end of the main building. It is placed on the flat car directly from cableways coming from the quarry. A track extends the length of the building and at each end there is a dump. There are two pairs of circular saws, three Disston and one Hoe, at each end and there are two 2 ton Box traveling cranes—one for

Interior Plant View Showing Trimming Shop



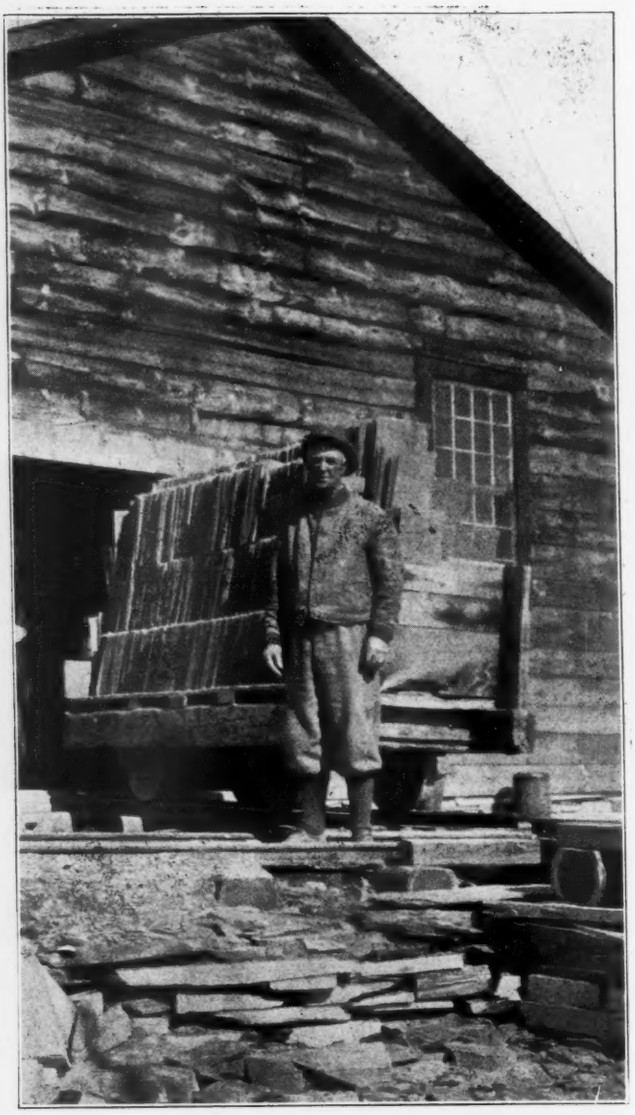
DIAGRAMMATIC LAYOUT OF SLATE MILL FOR MOST EFFICIENT ROUTING

each pair of saws. Thus it is plain that there is a separate entry for raw material for each pair of saws, separate cranes to serve them and separate outlets for waste material. However, the layout is flexible so that if circumstances call for it any means necessary to keep all parts of the shop busy may be taken. An important point is that everything is convenient, even the dumps and that material for the trimming shop progresses toward the center of the building where the tracks lead in to the trimming machines.

The sawed pieces which are ready for the splitters are placed close to them. As these men prepare the slate they place it next to another line of tracks entering the trimming shop which is at right angles to the saw and splitting shop. At the splitters station we find that a most practical idea has been carried out for the comfort of the men and that is that a separate square of good sized steam pipe resting on the ground has been placed around the seat of each. The winters are cold in this part of the world and the doors must necessarily be opened and shut off and on all day so that adequate heating is absolutely essential for men who are sitting in about the same position all day. This square of steam pipe would seem to be the answer to the heating question so far as these men are concerned.

The Ruggles trimming machines are all located along one side of the wing devoted to that purpose. The split slate is brought in from the other section of the building on the trucks and distributed where needed and as the finished roofing slate accumulates it is taken out to the yard on another truck,

Upper Right Shows a Quarry Block Being Lifted to Saw. Bottom View Shows Splitters Setting in Their Squares of Steam Pipe



R. Temple Jones, Superintendent Standing by a Load of Finished Slate

all by men assigned to that work and having nothing to do with trimming except to keep the trimmers busy and free from accumulations of rubbish and finished stock.

The floor plan of this mill looks very simple, which in fact it is. But there is a great deal of food for thought that a rearrangement of layout, involving little or no new machinery can result in something like 45 per cent increase in output with the same number of men. Certainly the greatest credit is due to those who conceived the plan and to those who carried it into effect. It is startling to see what remarkable results may be obtained by a simple but adroit application of intelligence.

Very Much Appreciated

Thos. H. Bellrose, president, the Bellrose Sand Company, Inc., Ottawa, Illinois, writes of the Hand Book as follows: "This book is very much appreciated and we wish to assure you that we will make use of the information and advertising."

Setting and Hardening of Cements

Without doubt the setting and hardening process of cements is at least partly concerning with the solution of the cement granule, and by making use of the influence of water, it is possible to observe four sharply differentiated processes.

1. The crystallization of needles.
2. The crystallization of plates.
3. Separation of a gel.
4. The transition of the gel to the crystalline state.

The effects of various dilute solutions, such as HCl, H_2SO_4, NaOH, $Ca(OH)_2$, ten different salts including sea water, as well as sugar and gelatine solution were investigated upon the setting and hardening properties of three different cements, $\frac{n}{10}$ HCl, NaOH, $Ca(OH)_2$, $CaCl_2$, Na_2SO_4 and Na_2CO_3 in dilute solution all accelerate the setting. Some of these exert specific actions. Sodium carbonate causes the formation of calcium carbonate in assisting the setting. Sodium sulphate forms gypsum. Hydrochloric acid accelerates the setting by solution of the lime, causing the presence of a large amount of calcium ion in a short time. All the other solutions used caused a retardation of the setting. K. Biehl (Zement, March 22, 1928).

Molded Concrete & Standard Strength

The standard tests on concrete have no relation to the properties of the concrete if it is molded. Due mostly to the extremely high excess of water added to the concrete mix for molded concrete, the strength of the resulting casting is very much below the value which might have been predicted. The slight strength of molded concrete in comparison to plastic or tamped concrete indicates its use mainly for massive and very little for construction, requiring strength. Especial care in the use of molded concrete must be taken in regard to the graining of the aggregate, the increase of the cement ratio, the use of trass, etc. A. Guttmann (Tonindustrie Ztg., March 14, 1928).

A Most Comprehensive Work

John C. Best, president of The Best Brothers Keene's Cement Company, Medicine Lodge, Kansas, writes: "We have just received the 1928 edition of the Pit and Quarry Hand Book. This is a most comprehensive work."

Worth a Great Deal

H. P. Armes, Sales director of the El Dorado Lime and Minerals Company, San Francisco, makes the following statement: "1928 Hand Book just received. Consider it worth several times the subscription price of Pit and Quarry."

BUDGETING PLANT EQUIPMENT EXPENDITURES

By J. J. Berliner

TO KEEP the plant and equipment operating efficiently involves a large number of constant expenditures. These expenditures may be classified as follows:

(1) Repairs—These expenditures are necessary to keep the plant and equipment in such condition that it can be operated efficiently.

(2) Replacements—These are expenditures made to replace old equipment that is worn out and discarded. After a certain period of time, equipment reaches the point where it can no longer be operated profitably and must be replaced by new equipment.

(3) Improvements—These are expenditures for new patents and improvements to equipment, lengthening the life of the equipment or increasing the capacity or efficiency of the equipment.

(4) Additions—These are expenditures for new equipment caused by the expansion of the business to take care of the increased volume of business.

To maintain an effective control over expenditures for plant and equipment, the following is necessary:

(1) A proper analysis must be made of the expenditures to determine their classification, and a record must be kept to show correctly their effect on the financial condition of the business.

(2) A proper control must be exercised over the amount of the expenditures sufficient to provide a well equipped and efficient plant, and at the same time, prevent the expenditure of more than is necessary to secure this result.

How to record Plant and Equipment Expenditures.

Repairs—From the accounting viewpoint, repairs are usually considered as a current expense to be charged against the income of the period in which they occur. However, if for any reason, the cost of repairs fluctuates and it is desired to distribute the repairs evenly, this may be done by estimating the average cost of repairs on the basis of past experience, and future estimations and setting up a reserve for repairs. Under this method there will be charged to expense and credited to reserve for repairs at the end of each period, an amount equal to the estimated average cost of repairs. As the repairs take place, they are charged to the reserve for repairs. Since the credit to the reserve account is not made until the end of the period, and the repairs are charged to it during that time, the account may show a debit balance during the period, but this balance will be adjusted by the credit entry before the financial statements are compiled.

Replacements—The cost of replacements is not an expense of the period in which the replacement takes place, but of all the periods during which the equipment that is replaced has been used. Thus, if a machine cost $2,000 in 1922, is replaced in 1927 by another machine costing the same, each of the five years should be charged with a part of the cost. If the scrap value of the machine is $200, the five years must be charged with $1,800 ($2,000-$200) or $360 for each year. Since the actual expenditures for any particular equipment take place at one time, and not during each year of its use, it is customary to credit the estimated depreciation to a Reserve for Depreciation account and to debit an expense account for the same amount. When an asset is sold or discarded, it is charged against the reserve account. By this means, the cost of equipment is charged against the income of the periods which benefit from its use.

Improvements—When improvements are made, future periods will be benefited either through the increased efficiency of the equipment concerned, or through its longer life, and hence the postponement of replacement costs. In any case, since future periods are to receive the benefit of such improvements, these periods should bear their cost. Hence, improvements are charged to asset accounts, and are not reflected in the expense accounts of the period in which they are incurred.

Additions—As additions, like improvements, are expected to benefit future periods, their cost is not charged to the period in which they are obtained, but is distributed over the periods during which they are used, by means of the periodical depreciation charges. Hence, additions are capital, and not revenue, charge.

Summarizing the foregoing, plant and equipment expenditures can be divided into two main groups:

(1) Those which are made in order to maintain the present equipment. Repairs and replacements are included in this group. Such expenditures may be termed maintenance costs. They must be included in the periodical expense accounts.

(2) Those which represent an addition to the assets of the business. Improvements and additions are included in this group. Such expenditures are termed plant and equipment costs and are charged to the asset account.

Controlling Plant Equipment Expenditures

To exercise effective control over disbursements for plant and equipment, the following things are necessary:

(1) Data must be available to show results of

past operations and serve as the basis of future plans.

(2) After all the available data has been considered, the plans which have been formulated must be expressed in workable form by means of a budget on plant and equipment. Sometimes two budgets are made, one on maintenanc costs and one on the cost of improvements and additions. The requirements for each are sufficiently similar to make their joint discussion possible.

(3) After the budget is completed, it is necessary to have records and reports prepared which will make possible the control ot such expenditures and the enforcement of the budget plans.

The data required to serve as a basis for the control of plant and equipment expenditures may be obtained from the four following sources:

(1) The accounting and statistical records with reference to past experience.

(2) Calculations based on predetermined factors.

(3) The consideration of future plans.

(4) The investigation and study of experts.

To control expenditures for plant and equipment, it is necessary to make first, a proper classification of the plant and equipment and secondly an accurate estimate of plant and equipment expenditures. In a manufacturing business for instance, plant and equipment expenditures will vary with the production program. If the production program is to be increased, it will be necessary to do one or both of two things: (1) Secure additional equipment; (2) Use present equipment more extensively. In either case, additional expenditures will be incurred and the amount of their production capacity can be estimated. For past production capacity to be obtained accurately, a record of each unit of equipment is necessary.

If the present equipment is to be used more extensively, this will increase the maintenance cost, and an estimate of this increase must be made. It should be obvious that a change in the production program may not affect all the equipment of the business to the same extent. For instance, it may be planned to increase the output of only one department; and if the previous maintenance expense of this department is shown separately from that of other departments, a more accurate estimate of the increase can be made. It will be necessary, however, to know more than the total cost of the maintenance of the department. The new program will probably affect some units of equipment in the department more than it will others. It is desirable, therefore, to have records which will show each unit of equipment in the department, and the maintenance expense incurred on it. This is accomplished by keeping a plant ledger.

A plant ledger is a record which contains an account with each unit of plant and equipment. It serves as a subsidiary record to the controlling account or accounts with plant and equipment kept on the main ledger. The plant ledger is usually

PLANT AND EQUIPMENT BUDGET

Group	Old Equipment			New Equipment				Total Depreciation	Total Repairs	Value of Total Equipment at End of Period
	Amount at Beginning of Period	Estimated Depreciation	Estimated Repairs	New Equipment Required	When Needed	Estimated Depreciation	Estimated Repairs			
1	2	3	4	5	6	7	8	9	10	11

EXHIBIT I

kept on cards or loose-leaf sheets, each card or sheet providing a record of one unit of equipment. The size of this unit will depend on conditions. There may be a separate account for each machine, or, if several machines of the same pattern and size are purchased at the same time, they may all be recorded in one account. Each account in the plant ledger, however, should show at least four things:

(1) The original cost of equipment and the date of purchase.

(2) The amount of depreciation accrued on the equipment to date.

(3) The amount of repairs made on it to date.

(4) Its present book value.

The repairs entered on the plant ledger account do not affect the value of the equipment since they are treated as an expense and are never added to the asset. It is, however, useful to have them entered on the plant ledger account for memorandum purposes so that in making future estimates, it is possible to obtain information of the past cost of repairs, not only in total, but also by departments and by units.

An equipment wears out, its replacement must be provided for. This provision is accomplished by charging a certain amount to the expenses of each budget period and crediting a like amount to a reserve for depreciation. In the calculation of the depreciation charge, three things are considered; The original cost of the asset, its anticipated life, and its estimated scrap value. By subtracting the scrap value of the asset from its original cost, it is possible to determine the cost of the use of the asset during its period of life. This cost is usually distributed over the period of its life in such a way that each budget is charged with its equitable share.

After the maintenance costs of past periods, as shown by the accounting and statistical records, have been obtained, it is necessary to determine the effect of future plans on these costs. If, for instance, a large increase in production is planned, the increased cost of maintenance arising from this increased production must be estimated. If new methods of manufacture are to be employed, the resulting change in maintenance cost must be calculated. If new equipment is to take the place of old, the maintenance cost will be affected. If it is planned to keep the equipment in better repair so as to make it more efficient and to prolong its life, this change must be considered. These, as well as other factors, affect the cost of maintenance and all must be considered.

In considering the relation of maintenance cost to future plans, various comparison should be made. Some items of maintenance cost will vary in proportion to production volume. To estimate these, it is necessary to determine the rates of the volume of production to these costs during the period. By applying this ratio to the estimated volume of production for the current period, an estimate for

MONTHLY REPORT ON APPROPRIATION

NAME OF APPROPRIATION	NO.	PERIOD	PER CENT OF COMPLETION	ORIGINAL AMOUNT	ADDITIONS	DEDUCTIONS	FINAL AMOUNT	CASH DISBURSED	ACCOUNTS PAYABLE	DISBURSED BALANCE	CONTRACT FOR LABOR & SUPPLIES	BALANCE AVAILABLE FOR FUTURE CONTRACTS
1	2	3	4	5	6	7	8	9	10	11	12	13

EXHIBIT II

the period can be obtained. Some items of maintenance cost will vary more nearly with the floor space used than with the production volume. Therefore, the ratio of floor space used in the past period to these items of maintenance expense during the same periods will be obtained, and the ratio applied to the estimated floor space of the current period. Other items of maintenance costs may vary in proportion to the number of units of equipment used and their amount will be correspondingly increased.

It is desirable that a periodical inventory or appraisal be made of plant and equipment and used as a means of checking the plant ledger and as a basis for budgetary plans. By this means inaccuracies in depreciation estimates and inadequate repairs can be discovered and corrected. It is also possible that too liberal depreciation may be allowed or too extensive repairs made, and such an appraisal will disclose this fact. Such an appraisal will also show when it is better to purchase a new machine, rather than repair an old one.

Many manufacturing concerns have on their staffs a plant engineer, who is responsible for the production, use and maintenance of plant and equipment. The engineer should be responsible for:

(1) The study of improved methods of factory construction.

(2) The study of present factory layouts and presentation for the approval of the executive in charge of production of proposals for improvements based on costs involved and savings made.

(3) The study of machinery, equipment and tools, and the presentation for the approval of the executive in charge of production of proposals for changes based on costs involved and savings made.

(4) The preparation of a periodical plant and equipment program based on studies, made in collaboration with the works planning and engineering departments.

(5) The presentation of the plant and equipment program to the executive in charge of production for approval and transmissions to the control executive committee of the company.

(6) The preparation of a periodical maintenance plan as proposed by the works maintenance departments and detailed by the works engineering departments.

(7) The presentation of the maintenance program to the executive in charge of production for approval and transmission to the central executive committee of the company.

(8) The supervision over the execution of the plant and equipment and the maintenance programs as approved by the central executive committee of the company.

Formulating the Budgetary Plan—This involves a consideration of (1) the contents of the plant and equipment budget; (2) the responsibility for its preparation; (3) the form in which made; (4) manner in which used.

The plant and equipment budget should state the following: (1) the anticipated repairs and estimated depreciation on the present plant and equipment; (2) the estimated cost of new equipment which should show: (a) Cost of factory equipment, and (b) cost of equipment for administrative and selling units of the business; (c) anticipated repairs and estimated depreciation on new equipment.

The executive in charge of production is responsible for the preparation of the plant and equipment budget so far as it relates to the factory. This responsibility he will delegate to the plant engineer who in turn will employ the assistance of the works maintenance department and the works engineering department. In calculating the depreciation charges, they may avail themselves of the services of the accounting department as well.

No standard form for the plant equipment budget can be presented. Form 1 shows what information it should contain. In filling in columns 4 and 8, the plant engineer will consult the works engineering department for information with reference to the cost of repairs. The works maintenance department will supply information with reference to the amount of repairs to be made. If the company produces its equipment, the works engineering department will supply the data needed for column 5. If the new equipment is to be purchased from outside vendors, the purchasing agent will supply this data. Column 6 on the plant and equipment budget states when new equipment is desired. With this as a basis, the purchasing agent will state the terms, on which the equipment will be purchased and show the date of payment. This information is necessary for the preparation of the financial budget. If the equipment is to be produced by the company, an estimate must be made of the disbursements necessary for its production. The date given in column 6 is the date when the completed equipment is desired.

The budget for plant and equipment consists of an estimate of the expenditures necessary for maintaining the present equipment and the securing and maintaining of the additional equipment demanded by the budget program. After such a budget has been prepared, it must be approved by executive authority.

Its approval consists in the making of various appropriations for the necessary amount to cover the cost of the various items included therein. After these appropriations are made, it is customary to delegate to some official of the concern the authority to grant expenditures under each appropriation. That this executive may exercise effective control over such disbursements, it is necessary that they be made only on requisition or request. When repairs or additions to plant or equipment

are desired by any department, the head of this department should submit a requisition to the executive to whom the responsibility for exercising such control over disbursements has been delegated. Such requests should be accompanied by an estimate of the cost of repairs or additions. If equipment is to be purchased from outside vendors, it is easy to obtain the purchase cost and submit it with the requisition. If additions to plant or equipment are to be constructed by the company, an estimate of the cost of the construction must be made.

The estimate of the cost of repairs or construction can be made in two ways. If the business maintains an engineering department, this department can be asked to make the estimate. If it is not possible or not desirable to have engineers make the estimate, it can be made by the cost accounting department on the basis of statistics obtained from the records showing previous costs. If co-operation between the accounting department and the engineering department is secured, more accurate estimates will be obtained.

If the requisition calls for the construction of equipment by the factory, careful records should be kept of the cost of the construction. The method of determining these costs is very similar to the method of determining the cost of goods manufactured for sale. Each requisition, after it has been approved, is given a number, and a construction order is issued authorizing the job. The construction order has the same number as the requisition. An account is opened on the cost records and all costs incurred in the construction are charged to this account. When the construction order is completed, a report is made to the executive who supervises the expenditures for construction showing the estimated cost and the actual cost. If there is any considerable variance, it is due to inaccurate estimates or an excessive cost.

With the comparative figures available, it is possible to determine the cause of variation. Unless such comparisons are made, it is impossible to exercise any effective control over the cost of construction work. Every attempt should be made to obtain accurate costs in connection with construction and repair orders. Unless such costs are accurate it is impossible to judge the efficiency with which the work is done or to estimate accurately the cost of future work.

It is usually not possible to estimate exactly each item of plant and equipment cost which must be met during the budget period. Such expenditure cannot always be foreseen. It is desirable to anticipate these additional costs by including an item in the plant and equipment budget to cover them. Since these additional costs vary from period to period, it is well to credit a reserve account for the amount included in each budget to provide for them. When the costs are incurred, they can be charged against the reserve. These additional costs may be due to rising costs of material and equipment, labor troubles, accidents, increased production, etc. By employing the method outlined above, they can be taken care of as they arise. It is obvious that this reserve has a limited use and must not be used as a means of hiding excessive amounts paid for construction or repairs during certain periods. If this reserve is too large, it prevents proper control.

To exercise effective control over the plant and equipment budget, it is necessary to have periodical reports which will make possible a comparison between the amount appropriated for each class of expenditures and the actual amount expended. A report should be made monthly giving the comparison as shown in form 2.

The report is of service not only to the executive who has control of the purchases and construction of plant and equipment but also to the financial executive. The report shows the former the amount available for future purchases or construction, and it shows the latter the amount which he must plan to finance. The tenth column gives the treasurer information of special value since it states the payments to be made in the near future. Column 13 shows the amount which may be diverted to some other purpose in case of financial stringency. If the executive committee receives this report each month, it can exercise an effective control over all disbursements.

Concrete Buildings Going Higher

A distinct trend toward the use of reinforced concrete for high buildings is revealed in a survey of this type throughout North America, recently completed by the Portland Cement Association.

South America is the most sensational adapter of the concrete building idea. the Hotel Palacio Salvo at Montevideo, Uruguay, being the highest building of its type in the world. It rises to a height of 28 stories, with its peak 338 feet above the sidewalk level. The Palacio was finished in 1926.

The tallest concrete building in the United States is the recently completed Master Printers Building, New York City, which has 20 stories and an over-all height of 310 feet.

While the first concrete building above ten stories in America, the Ingalls Office Building at Cincinnati, Ohio, finished in 1903, stands 16 stories high, the average number of stories for the 647 reinforced concrete buildings in this country, ten or more stories high, is 11.9, the survey shows.

Illinois is the leader among states in construction of tall concrete buildings with a total of 110; California is second with 67; Texas is third with 57 and New York fourth with 47. The remainder of 366 buildings included in the survey is scattered over 33 states.

CONCRETE UNDER COMPRESSIVE STRESS

By Raymond Davis*

CONCRETE is a material which, when subjected to sustained stress, continues to yield, or deform, over a considerable period of time. To learn more of the influence of various factors, the author of this paper inaugurated a series of tests on plain concrete cylinders held in compression.

These tests were intended to show the time flow relation as affected by the cement ratio; graduation of aggregates; moisture conditions of storage; age at time of loading; and the magnitude of compressive strength. Tests were conducted in the Materials Testing Laboratory of the University of California with Santa Cruz Portland cement, Niles gravel and crushed stone, stressed to 640 pounds per square inch. They are divided into two series, designated after the year in which observations were begun. In all, 69 specimens were subjected to sustained load and the temperature was maintained constant at 70 degrees Fahr. with the relative humidity at 70 per cent.

The 24 specimens of the 1925 series were 6 x 24 inch cylinders, divided into four groups. One group was of rich mix, 1:4, and high fineness modulus, 6.60; a second of lean mix, 1:7, and high fineness modulus; a third of rich mix and low fineness modulus, 3.52; and a fourth of lean mix and low fineness modulus. To determine the influence of moisture one half the specimens were stored in air of 70 per cent humidity and the remainder were stored in water spray at 70 degrees, Fahr. One specimen from each group was stored in air without being stressed in order that observations might be made and corrections applied to the observed deformations of the loaded specimens to allow for changes in length due to causes other than flow. These specimens which were stored in air during the loading period were cured approximately two months in water and five months in air before the load was applied and the specimens which were kept wet after loading were stored continuously under water prior to loading. The load was generally applied at the age of about seven months.

Flow, as defined in this paper, includes only that plastic deformation which occurs subsequent to the aplication of load.

The specimens of the 1926 series were 60 cylinders, 4 by 14 inches, of a similar mix to 1925 specimens of which 45 were subjected to constant sustained loads producing compressive stresses from 200 to 1,200 pounds per square inch. The remaining 15 were stored without being stressed to make observations. The water cement ratio was 1.03 by volume or 0.64 by weight and the average slump, as determined by the standard test, was 3.2 inches. The series is divided into 15 groups, of which some were stored in water 70 degrees Fahr. and some were stored in air at 70 degres Fahr. with 70 per cent relative humidity. Nine groups were stored in water and six groups were stored in air with loads of 200, 300, 600, 900 and 1,200 pounds per square inch applied.

For both series, deformations were measured with a strain gauge with lines at the third points of the circumference of each specimen. Deformations were observed for the 1925 series with a 20 inch Berry strain gauge and observations were taken for the 1926 series with a 10 inch fulcrum plate strain gauge.

The load was maintained constantly by means of a car spring being clamped to the specimen and reacting against one end of the cylinder. When the desired load had been applied, the nuts on the rods of the load sustaining apparatus were brought to a bearing against the endplates and when the load on the testing machine was released, the compression in the spring was maintained by tension in the rods. In no case has there been discovered a difference between the original load and that existing after an interval of time.

It was observed that the leaner the mix the greater the flow, since after five months of sustained load in air for concrete of fineness modulus 6.60, the flow of the 1:7 mix, amonuting to .02 per cent is double that of the 1:4 mix, and for concrete of fineness modulus, 3.52, the flow of the 1:7 mix amounting to .05 per cent is three times that of the 1:4 mix.

Apparently the smaller the fineness modulus the greater the flow as for a 1:7 mix, the flow of the group of fineness modulus 3.52 amounting to .05 per cent is double that of the group of fineness modulus, 6.60. It was also observed that, for the same consistency of mix, variations in graduation of the aggregate, as measured by the fineness modulus have a greater effect upon the magnitude of the flow when the mix is lean than when it is rich.

It was determined that the flow of concrete stored in air is greater than that of the same specimen stored in water spray, even although the conditions of curing are similar, during the early life of the two concretes. The flow of the high fineness modulus and lean mix of the 1925 series stored in air was three times as great as for the same concrete stored in water spray. The maximum flow for concrete stored in air is .022 per cent and for that in the water spray is .007 per cent.

*Abstract of paper presented before the twenty-fourth annual convention of the American Concrete Institute.

HOW TRACTORS SAVE MONEY

By Charles Geiger

A SAVING of 25 per cent or more through the use of track-type tractors has been reported by quarry owners throughout the country. Track-type tractors save time, labor and money in at least three major operations which often consume 75 per cent of the productive effort (stripping, loading and transporting) and perform many minor operations as well.

One quarry owner states that two track type tractors, each pulling two 3 yard dump wagons, replaced 12 teams and kept a ¾ yard shovel busy on hauls up to 800 feet. The saving in one year equaled the entire cost of the tractor equipment.

The ideal dump for a quarry is that one which is reached by a short haul, small area at the base and quite high. This tends to long and somewhat heavy grades. Track-type tractors work to this end where no other equipment does. They are readily adaptable to dozens of other jobs about the plant. Road maintenance, building moving, material haulage, spotting freight cars and, fitted with a winch to open up many new and useful hoisting jobs.

For example the tractor used in stripping can be employed to assist in the moving of large well drilling equipment over ground too rough or steep for moving the drill under its own power.

The track-type tractor expediates wrecking operations along quarry railway lines. With a winch attachment it can be used as a portable cable power or hoist unit for any kind of construction, repair, or moving work around a stone producing plant. It can be used in hauling supplies such as heavy drill stems, drill tools, blasting supplies, heavy repair parts, etc. It is used for moving heavy equipment and for spotting and switching cars. It is the best power unit to be had for building and maintaining roads about the quarry. It is used for snow removal in northern locations and is always ready and available for a large number of miscellaneous activities which every quarry superintendent develops for himself when he gets a tractor on the job.

With a tractor the pit or quarry can operate full time right through the year. The old idea of confining over-burden removal to the summer months can be as obsolete as the operator wishes to make it. Snow, ice, driving storm or sleet cannot stop the track type tractor.

Quarry operators have depended on getting their stripping done in the summer months, taking advantage of dry weather conditions. Their equipment is helpless in bad weather. Stripping starts in April or May and runs up to and including September. The quarry, however, continues to run the remaining six months and by the time that April has come again, they are up against it for stripped rock. It is then at least four or five weeks before they are in shape for quarrying, unhampered by close quarters and soiled rock.

Track-type tractors can be worked practically

Tractors Hauling Stone in Pennsylvania Quarry

anywhere every day that men will work. Stripping keeps ahead of quarry requirements, as it can become an all year operation, rather than a seasonable one.

The stripping of over-burden in quarries is each year becoming a more trying and expensive problem. Deposits at or near the surface are gradually becoming exhausted, resulting in a tremendous volume of overburden to be removed. The greater tonnages of rock being demanded, in turn, call for larger and more flexible loading units, with increased capacity of crushing units to correspond.

In order to keep ahead of the quarrying of rock, the quarry should be kept stripped back from the face a distance equal to twice the space between the line of blast holes and the face. For instance, if a single line of blast holes is drilled twenty feet from the face, the rock in back of that line of holes should be stripped an additional twenty feet, making a total of forty feet of stripped rock—this to assure no overburden falling into the quarry at time of blast.

The ordinary stripping operation depending on stone shipped per day, material to be stripped, topography of surface to be stripped and the length of haul is either by hand or power loading into wagons or carts or trucks or a power loading unit into cars hauled by locomotives.

Where stripping is lighter and length of haul is less, track-type tractors operate self-loading scrapers and perform the work quickly and cheaply.

The use of tractors in stripping operations very greatly reduces the investment in equipment. Stripping has been the first general use made of tractors in connection with quarry operation, because of their established efficiency in all kinds of dirt moving operations. For example, the follow-

ing are only a few of the many cement and quarry companies using track-type tractors in quarry operations:

The Annville Stone Company, Annville Pennsylvania, is stripping its quarry by contract. The contractor, A. A. White, is using three tractors for transporting strip material from shovels.

The H. E. Millard Company of Lebanon, Pennsylvania, with a capacity of 800,000 tons of crushed rock per year, is stripping with two tractors.

The Canadian Cement Company, Limited, is using five tractors at four of its Canadian plants to perform a variety of dirt moving operations and other work.

The Lawrence Portland Cement Company, with general offices at North Hampton, Pennsylvania, uses a tractor in the quarry and around the works at its Siegfried plant.

The Sandusky Portland Cement Company, Toledo, Ohio, is using a tractor for general utility work about the quarry and plant.

Where the length of haul demands locomotive transportation, tractors with bulldozer eliminates the dump gang and the track gang. The application of the tractor with bulldozer on the dump is to allow enough room between the track and the edge of the fill to operate the tractor. Cars are dumped directly on the dump. The tractor bulldozes material off the edge of the fill. One man is left on the dump besides the tractor operator to unhook and hook up cars. The present method is one foreman and a gang of men who are traveling over the entire track system and usually every day throwing track on the dump. Tractor track throwing is a matter of probably once a week. This, of course, depends on the quantity of material dumped per day and the length of the fill.

Cars are also righted by the vertical lift of the bulldozer. When it is necessary to throw either the loading track or the dumping track, this is done by pulling the track up and out of its bed by a line from the drawbar under the outside rail and hooking over the inside rail. Then from the other side of the track push the track with bulldozer to place. After the track is lined up it is ready for use.

This can be done without disturbing the gauge of the rail or kinking the track, provided it is cut on the curves.

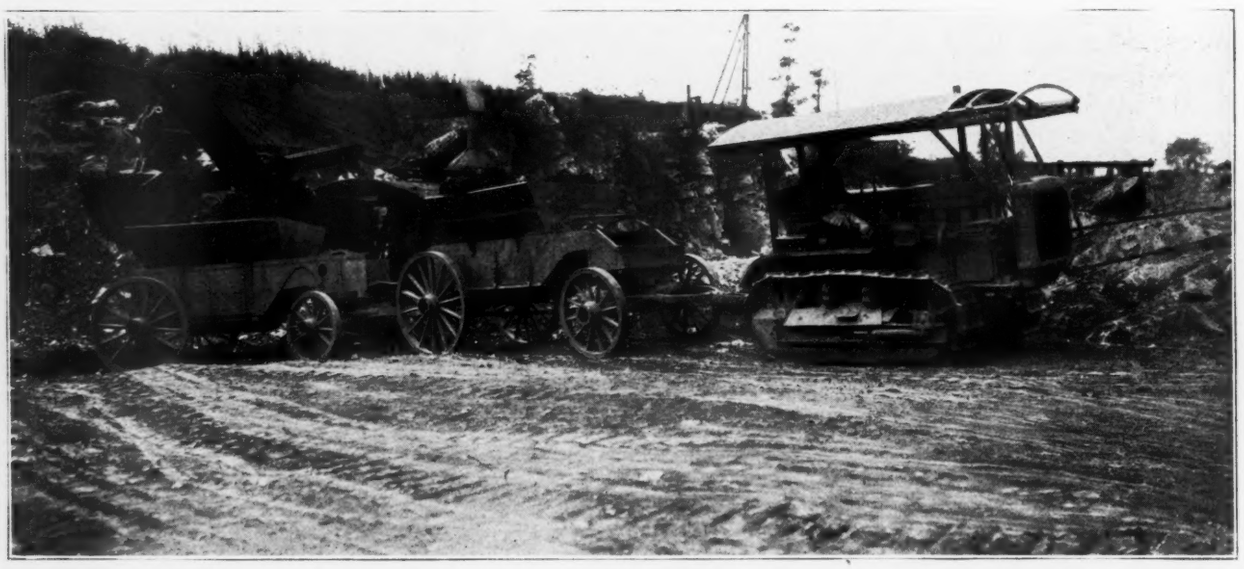
In one instance on a quarry floor a track type tractor with only its driver and one laborer, shifted 1,500 feet of standard gauge track a distance of 8 feet and lined it up ready for use in four hours. The track was built of 70 pound rails with standard ties at 18 inch centers.

On this same job, and under the same conditions of quarry floor, it required a gang of forty men ten hours to make the same shift of track before it was ready for use. The cost was approximately $150 for moving by hand and less than $15 for moving with the tractor.

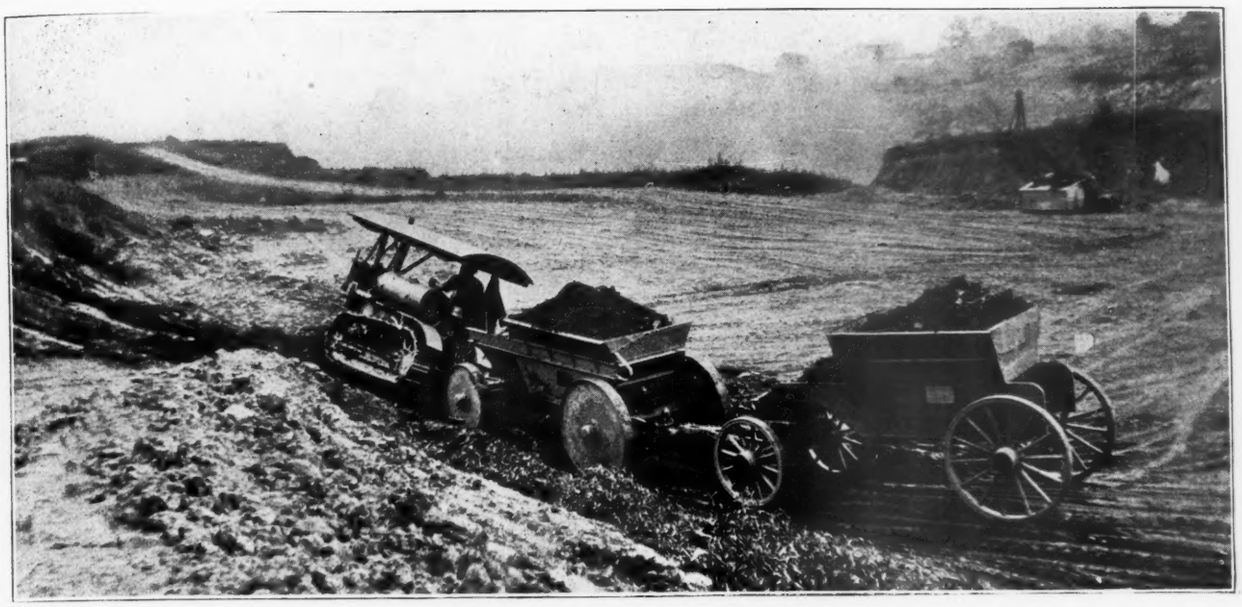
The floor of the ordinary large quarry in which locomotives and trains are used for transportation is covered with a series of rock windrows spilled over the cars in the process of loading with the shovel. This make a disorderly floor on which it is difficult to operate both men and equipment. This makes it nearly impossible to throw track. At the same time, it is an expensive waste of rock.

A track type tractor with heavy bulldozer pushes these windrows of waste rock back into the shovel pit where it will eventually be picked up and saved.

The track type tractor on the quarry floor is always ready and a most efficient power unit when it is necessary to move large "chain rock" too heavy for the shovel to handle. It is especially useful in those quarries where it is desired to separate and save large riprap material or special rock, not convenient to handle with the shovel. Such produce can be snaked out on quarry floor and collected for special handling better, quicker and cheaper.



Tractor Used to Haul Stone Loaded to Trailer by Shovel



Tractor Used in Stripping Overburden

Gathering rock has been a serious problem in all large quarries. The former methods of moving track and its frequent breakage during blasting operations, coupled with the expense, has driven many operators to try motor trucks.

A motor truck is an efficient piece of equipment for transportation at good speed over good roads where loading time is small in proportion to travel time. On the quarry floor, however, among the rough sharp rock and spalls, its tires are cut and ruined in a short time and this becomes an important item of expense.

Further, in loading trucks by shovels, a four thousand dollar power unit is depreciating, whereas by loading trailer wagons by shovels an approximately fifteen hundred dollar unit is depreciating. While loading trucks it is necessary to hold a unit of transportation equipment costing about $6,000 with a capacity of only about six tons, or $1,000 per ton of capacity.

By using track type tractors with suitable trailers of ten ton capacity, it is necessary to hold only the trailer units while loading, since the tractor is on its way with another load. The trailer units waiting to be loaded would cost less than $2,000 for a ten ton unit or less than $200 per ton of capacity for the waiting equipment.

A track type tractor costing $5,000 will haul from 20 to 40 tons of rock from quarry floor to delivery point, depending upon grades and conditions, while a track type tractor costing $3,000 hauls from 10 to 20 tons, depending upon conditions.

The development of heavy steel trailer wagons arranged for bottom dumping, as well as side dumping, promises to largely increase the use of track type tractors in gathering stone in quarries.

In some quarries operating in mixed materials or producing selected rock for special purposes, it is necessary to load the rock by hand as a means of sorting. In such cases large flat skips or scale boxes can be hauled on low, flat, heavy trailers behind tractors. Such trailers may be had with floors only 28 inches from the ground and in capacities varying from 2 tons to 20 tons. This permits easy hand loading because of the low elevation of bottom of skip, while the large floor area of the trailer makes it possible to haul a large load efficiently. On such operations, extra trailers are spotted for loading while the tractor hauls its load to delivery point.

Such trailers and operating methods are especially useful for quarries located in deep pits. The heavy skips—or glat scale boxes can be lifted by derrick from the trailer at delivery point and elevated to the surface of the ground, or swung directly to crusher platform, as may be required.

Slate and Crushed Stone Industries to Have Cost Studies

Following conferences held with the Secretary of the National Slate Association and with a number of the leading slate producers to ascertain how the Bureau of Mines might best assist that industry, it has been determined to undertake a study of production and marketing costs. Costs constitute the backbone of most economic studies, it was pointed out. A cost schedule is being prepared. The National Crushed Stone Association, at its recent convention at West Baden, Indiana, voted unanimously to cooperate with the Bureau of Mines in a detailed study of production costs. A cost questionnaire has been prepared and will be forwarded to approximately 2,500 operators.

HARTFORD SAND AND STONE COMPANY DEMONSTRATES MANY ECONOMIES

By George Ransom

NUMEROUS developments of an interesting character have taken place at the trap rock quarry of the Hartford Sand and Stone Company at Farmington, Connecticut. Perhaps nothing can more plainly demonstrate the ability and ingenuity of an owner or operating superintendent than the manner in which his quarry is developed. This is especially true where the quarry is in the form of a pit rather than a cut in the side of a hill or mountain.

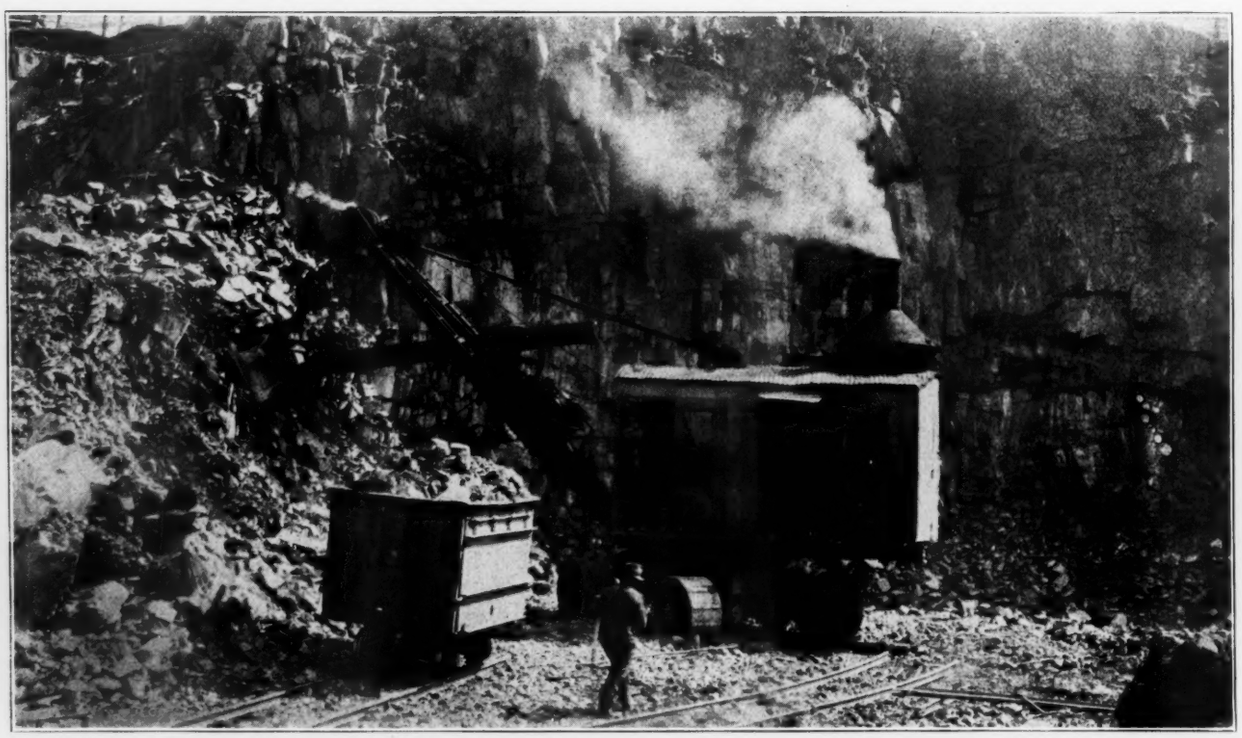
Mr. Cooke's quarry is most decidedly of the pit type and calls for elevating all stone taken out a distance of some 40 feet to the primary crusher. The only way in which this can be done is by dump cars hauled up an incline by a hoist engine at the top. Unless the operations centering around this incline are very carefully looked after very serious inefficiency will result.

Formerly the quarry was only about half as deep as at present, so that the incline to the primary crusher was not so much of an item. However, by about the autumn of 1926 the floor of the quarry covered so much ground that it was decided to work a lower bench and lengthen the incline.

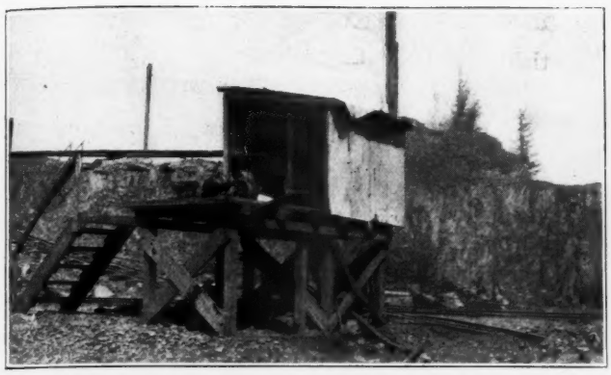
The seams in the trap rock here are such that drilling with the X-70 drills can be most readily done horizontally. Where the breast exceeds about 30 to 35 feet the "flat" holes are drilled in two benches, one set at the bottom, the other about half way up. They are made about 25 feet deep and 6 feet apart and are charged with Hercules Gelatine Extra L. F. 60 per cent dynamite. Both benches are fired simultaneously.

New Shovel Being Prepared for Service

In the pit there are two Marion steam shovels—a No. 31 and a No. 32. These load the stone into dump cars designed by Mr. Cooke, as explained in previous articles in these columns, which are hauled to the foot of the incline by two Plymouth gasolene locomotives. It is characteristic of the good management of Mr. Cooke that, at the time of the writer's last visit, one of the shovels was engaged in clearing up the floor of the quarry. The loose stone so collected eventually goes to the crusher and the quarry is maintained in a manner to facilitate re-



Steam Shovel Loading Quarry Car



Pump is Mounted on Raised Platform in Quarry

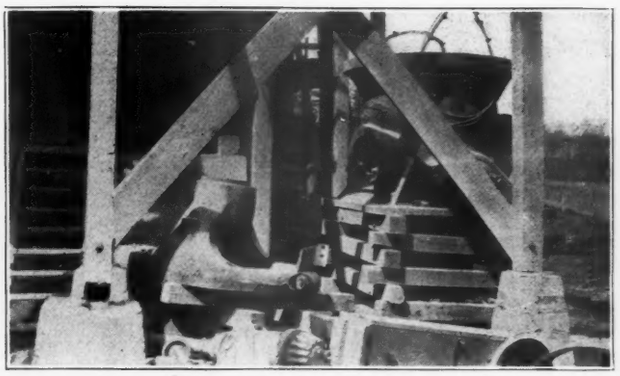
laying tracks and to make walking less dangerous.

The pit of course collects water and must be pumped. Three centrifugal pumps, mounted on a raised and covered platform, are used for this. They are as follows:—

Make	Suction	Discharge	Motor
Economy	8″	6″	Howell
Ramsey	4″	3″	Century
Erie	3″	2½″	G. E.

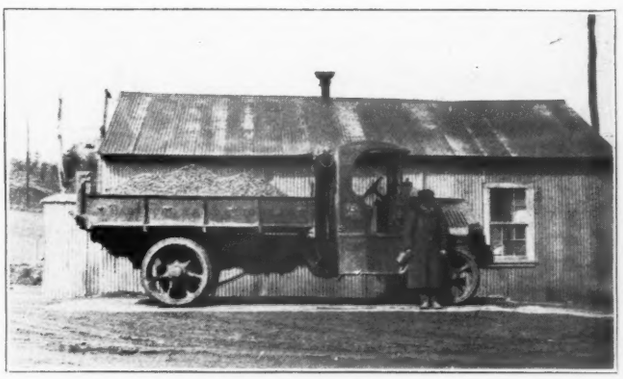
These operate entirely independently of each other, having separate suction and discharge pipes as well as separate motors.

Some entirely new equipment has just been purchased and installed for the coming season. This includes a new 200 h.p. Westinghouse slip-ring motor to drive two gyratory crushers, two elevators and three screens. There is still a surplus of power available for future additions to the load but in the meantime the power factor is kept from being excessively low by two Westinghuose synchronous motors, of which one, of 150 h.p., drives the primary crusher and the other, of 100 h.p., drives the secondary gyratory crusher.



New Crusher Being Installed

A new type C Allis Chalmers gyratory crusher is also about to be installed, as a result of the good results which have been had with similar crushers at Mr. Cooke's plant at Swampscott, Mass.



This Truck Has Covered 115,000 Miles

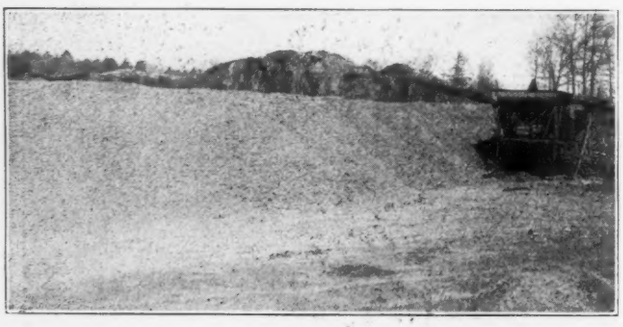
In addition to this a new Marion No. 32 steam shovel equipped with caterpillar traction has been purchased, in part to have a shovel in reserve in

New Part of Quarry

Note Neat Appearance of Trucks

case of break down of one of the other shovels and in part for loading trucks from the stock pile. These stock piles are temporarily located in an old part of the quarry which has not yet been cut to the lower level. Here there is also a Blaw-Knox adjustable batcher used to prepare dry mixtures for road construction jobs.

Aside from the interest attaching to the new equipment some very interesting facts were brought to light relating to old equipment. These had to do with the motor trucks used to make deliveries to customers. There is a fleet of fourteen 10 ton Mack trucks. Three of them have seen six year service. Truck No. 2, shown in one of the illustrations, had been run about 115,000 miles! The reason why such performance is possible, aside from the fact that they are good trucks to begin with, is that the trucks are a hobby with Mr. Cooke. They are well kept up in every way. They are conspicuous by their neat and clean appearance at all times. As they are conspicuous on the streets of Hartford and the highways of a rather wide and well settled section of country they are of real advertising value. Consequently an occasional painting and frequent washing is a good investment. A first-class mechanic is employed at the Company garage to keep the machinery in good working order. Nothing is allowed to go until a breakdown is imminent or actually occurs. They are never run if not in first-class condition. Whenever it seems necessary the trucks are given a complete overhauling. It is the only way, Mr. Cooke feels, to keep operating costs at a minimum, to insure the quickest service to customers and to secure the full advertising value which they make possible.



Stock Pile With Batching Bin

New Ideas About Concrete

It is suggested that concrete—or at least the cement part of it, and more especially when rapid hardening cements are used—is capable of yield and flow. This suggestion arises from observations that concrete made with rapid hardening cement was much more impermeable than that made with ordinary cement, and was thus less liable to the microscopic cracks which appear to cause permeability. The strains induced during the period of shrinkage, might, therefore, have been released by the ability of the concrete to flow. The importance of curing and of limiting the proportion of water in the concrete mixture is emphasized when the subjects of shrinking and "crazing" of concrete are considered. A more fundamental remedy, the use of pozzolanas, is being investigated. A distinction is drawn between the real strength of concrete and its apparent strength as determined in the laboratory. The result may vary from 1,600 to 2,200 pounds per square inch by varying the type of end packing used in the tests, such as wood, steel or rubber packing pieces. The shape of the test piece is also of great importance, as is shown by the fact that the strength increases by 15-17 per cent when cylinders used for the test have the ratio of height to diameter changed from 1 to 2.

The cement mortar having the greatest resistance to abrasion was found to be a ratio of cement to sand of 1:1. Editorial (Concrete, March, 1928, on Report of the (British) Building Research Board).

Damaged Cement

The finer grinding of cement becomes more pronounced every year and the cement of today may, in the case of the rapid-hardening varieties contain more than 80 per cent of "flour" compared with 45-50 per cent in the cement of 1910. It is only natural that the attraction of cement for atmospheric moisture increases with its flour content, and thus the superfine cements of today are particularly susceptible to loss of strength on storage. The proportion of water that a neat cement retains for complete chemical hydration is only about 13 per cent, and when a cement has absorbed 3 per cent of water it has probably lost nearly a quarter of its hardening qualities. The danger of damage can be minimized, perhaps, by the replacement of jute sacks, which are porous, by three or four-ply paper sacks by cement manufacturers. Editorial (Concrete, March, 1928).

A Comprehensive Encyclopedia

A. Guidal, manager of the Ship Canal Portland Cement Co., Ltd., Llandudno, writes the editor concerning the 1928 Pit and Quarry Hand Book as follows: "It is a very comprehensive encyclopedia of the pit and quarry industry."

PROGRESS IN GERMAN CEMENT TECHNOLOGY

IMPORTANT papers read at the Fifty-First Regular General Meeting of the Society of German Portland Cement Manufacturers, Berlin, March 13-15, 1928 are presented here.

Chemistry of Rapid Hardening Cements

By Dr. Hans Kuhl

Although there is a widespread opinion that the manufacture of rapid hardening cement is merely a technological problem, the fact must not be overlooked that chemistry plays a very important role in the formation of cements with high early strengths. The chemical composition of the raw slip and of each constituent thereof has very great influence upon the "hardening power" of the finished burned clinker. That a raw cement mixture must be standardized with exactness so that a lime content once recognized as correct may always be obtained even when the raw materials are high in lime, is a basic chemical principle. But other ingredients also affect the value of the product, especially the three hydraulic factors, silica, alumina and iron oxide. If the silicate modulus is so altered by means of correct additions of silicic acid, alumina and iron oxid to a given slip, so that the silicate modulus is changed in a series of graduated steps from very high to very low values, it is found—assuming that the correct lime ratio, uniform burning and similar degree of fineness of grain are obtained—the best cements are obtained at the extreme values of the silicate modulus, while at the intermediate values cements of poorer quality are produced. The highest strength figures are also found for cements produced with the uppermost or lowest possible proposition of silicic acid.

These facts find their technical expression in two manufacturing processes which produce "Velo" cement and "Bauxitland" cement respectively for commercial use. Velo cement is very rich in silicic acid, whose production is recommended by F. L. Smidth of Copenhagen. It has a silicate modulus of 3 to 4, its hydraulic modulus, as is indicated by its silicic acid content is extremely high and is about 2.3, even 2.4 in extreme cases. Raw materials with correspondingly high silicic acid content are rare in nature, so the silica content of the slip must be reused artificially by the addition of sand quartz or flint. The burning of such a slip rich in lime and silica, if no special assistants are used, required so high a temperature that regular plant production would offer difficulties. The addition of some fluorspar to the raw mixture is recommended, therefore, to make the sintering easier. The dead burned clinker must be very finely ground. The technical characteristics of Velo cement are preeminently good, even if it has been shown that the tensile strength often does not keep exact step with the high compressive strength. Technically the production of Velo cement is indicated for completely organized modern factories, namely, those which use the wet process and which, therefore, exhibit the possibility of exact control of the fluctuations of lime ratio.

"Bauxitland" cement has a low silica content and is produced by the C. O. Wegner Company in Germany. The feature of this cement is, that the alumina content is made as high as possible and the tendency thus given to the cement to set rapidly is compensated by raising the iron oxide content of the cement at the cost of its silica. The most advantageous result is obtained if the silicate modulus is kept at 1.25 and if the same value is maintained for the proportion between alumina and iron oxide. A clinker which fulfills these requirements contains about 18 per cent silica, 8 per cent alumina and 6½ per cent of iron oxide; its lime content is about 65 per cent which corresponds to a hydraulic modulus of only 2.0. Cements of this kind can be made from some raw materials simply by the addition of iron oxide. Most, however require of both iron oxide and alumina. It is at this point that precipitated bauxite becomes important, as well as ashes and slags rich in alumina which are obtained as wastes from industrial plants in several localities. The production of Bauxitland cements is appropriate for the small capacities of old plants.

But it is characteristic of Bauxitland cement that the strength curve to the left and right of the maximum values run proportionately flat; so that in the preparation, slight deviations from the most favorable chemical proportions will have little deleterious effect upon the value of the product. The cause of this phonomenon may be found in the fact that the raw slip, high in iron oxide is extraordinarily light. From the chemical viewpoint too, fluctuations in the composition of the raw mixture have only slight influence upon the quality of the cement, because, on the one hand, calcium silicates harden better the greater their lime content, which, on the other, aluminates poor in lime yield cements of the greatest strength. The cement must be such that its hardening power has some degree of uniformity based upon its content of silicates, and aluminates, and which gives a curve which is proportionately flat in the neighborhood of its optimum strength values.

The clinker need not be ground very finely to obtain satisfactory strengths. The process was tested in an American cement mill over a period of nine months and the mean values found were a tensile strength of 355 lbs. per sq. in., a compressive strength of 3,564 lbs. per sq. in. after 24 hours.

The highest values exceeded 425 lbs. per sq. in. in tension and 5000 lbs. per sq. in. in compression. The coal consumption in rotary kilns was about 19 per cent. In spite of its many advantages, it cannot be denied that the process has one difficulty which is involved in the extraordinary difficult sintering, although the earlier troubles in this respect are being successfully overcome and in America a rotary kiln operation is carried out without difficulty through 24 days. The plant design, after this interval must be recognized as a solution of the problem.

The contribution of chemistry to the production of rapid hardening cements is not exhausted with the determination of the essential constituents of the cements described above. I have only recently established the fact that the strength immediately after setting can be appreciably increased by the use of a flux to assist the sintering. The effect of fluorspar in this respect is already known. Its possibilities are not exhausted in facilitating the sintering, as larger amounts of fluorspar result in other specific effects. But, I refer to the not yet complete researches concerning calcium chloride, which indicate that the addition of 1 to 2 per cent of this substance to the slip facilitates the sintering and remarkably increases the early strength of the cement. The same precaution customarily observed with fluorspar must also be taken with calcium chloride that if the addition is not very small, it must be made certain—that the addition actually does increase the hydraulic modulus. It has not yet been determined whether the action of the calcium chloride is due to its facilitation of the sintering or whether the calcium chloride still present in the clinker after burning causes the increase in the starting strengths.

Addition of materials to the clinker after burning also favorably affect the strength. The influence of certain silicates such as blast furnace slag which accelerates the hardening is already known. We have learned that not only through physical treatment but also by chemical stimulation by the use of blast furnace slag an astonishing acceleration of the speed of hardening may be effected.

Indeed, these methods were responsible for the preparation of cements from blast furnace slag. It is known very rapid cooling of blast furnaces slag is a decisive factor in its value as increasing hardening capability, insofar as only the quickly cooled slags are useful practically. And it is also known that alkaline and sulphatic agents may liberate the consideraable latent hardening power of the rapidly cooled blast furnace slags. And so in the case of Portland cement clinkers of dissimilar gravities, it may be assumed theoretically that the speed of burning and cooling are also here not without influence upon the hardening capability. But at the same time experience has shown that similar powerful effects to those obtained with blast furnace slag are not to be had with Portland cement. It is known, however, that Portland cement clinker can be made to harden better under the influence of proper exciting agents. Gypsum is one, but calcium chloride is especially effective. Unfortunately, the action of calcium chloride in increasing the strength of the cement, when it is used in quantities which have an appreciable effect, is combined with an effect of very greatly shortening the setting period. For this reason I have made efforts to find a material which will not cause rapid setting. Manifestly the chlorine is responsible for the increase in strength, so I attempted to find a method of incorporating chlorine with cement, so that its effect as chloride ion would occur only after a certain interval. Addition of a mixture of calcium chloride and calcium sulphide caused the cement to exhibit both an increase in strength and an acceleration of the setting. Possibly the chloride and sulphide react with each other by double decomposition to cause this effect.

On purely theoretical grounds I then added chlorine in the form of chloroform and other organized compounds. The details of these experiments will be published later. I then carried out an extensive series of researches each time altering the cation as well as aniom in each experimental series of the added substances. In the cation series chlorides were used in equinole cular amounts, corresponding to an addition of 2 per cent calcium chloride to the cement. These cations increased the strength of the cement; lithium, aluminum, sodium, potassium, ammonium, calcium, strontium, barium. cadmium, aluminum and ferric chlorides. Without noticeable influence are: Magnesium, chronium, ferrous chloride, nickel and cobalt. These ions cause a decrease in strength: Maganese and tin, and to a greater extent zinc and copper. Destruction is caused by lead. The most powerful strength accelerators were both calcium chloride and calcium nitrate. In fact, after two days cements with these salts added showed an increase in tensile strength of about 20 per cent and in compressive strength about 50 per cent. Copper and zinc injured the cement so severely, that even after two and three days a strength test was not even possible, but after that a vigorous hardening took place, so that after seven and 28 days strength figures were obtained which were of the same order of magnitude as those of cement about to harden. Completely devastating was the effect of bad nitrate which caused a specially stable cement to blow badly. On the basis of the present state of our knowledge no scientific cause for such behavior can be found.

In similar manner the effect of the anions was studied by means of the sodium salts. It was found that bromine is considerably superior to chlorine as a hardening accelerator. Unfortunately its use on a large scale, for economic reasons, is

not to be considered. Iodic, phosphoric arsenic and boric lower the initial strengths very greatly. All of this work was performed only with one cement and with the same concentration of additive substance throughout, so there remains the enormous task to test the effect of each material on various cements. At the same time it would appear that this work would be worth while, in view of the fact, that in the most favorable case an increase of compressive strength from 824 lbs. to 3380 lbs. per sq. in. was obtained.

In view of the above described favorable influence of chemistry upon rapid hardening cements, in conclusion, I must emphasize the fact that in recent years more and more the development is indicated that the manufacture of cements will be coupled with other industrial processes. Here there appears the negative side of the influence of chemistry. The origin of blast furnace cements is referable to the requirements of the iron industry. The chemical industry has for its purpose not only the turning of waste products into articles of value but also to bring to the attention of the cement industry new manufacturing processes. The manufacture of Portland cement from gypsum is conjunction with sulphuric acid manufacture, has at last outgrown its swaddling clothes, and the chemical industry has succeeded in producing Portland cement originally inherent in gypsum due to its sulphide sulphur content. And now wherever large quantities of lime are involved, for example, in the working up of calcium, cyanamide into nitrogen compounds and in the manufacture of acetylene from calcium, carbide, the wasted lime cries to the utilized. These lime slurries are extraordinarily burdensome to the chemical industry, and doubtless will exert more and more pressure until finally something will be done to utilize them, which means, only, that they will be used for the manufacture of cement or other mortar.

According to recent processes phosphates will be converted to aluminous cements with the aid of coal and bauxite, and the phosphorus produced in the free state will be further converted. This process affords a large and cheap source of aluminous cement as a by-product. The possible yearly production is estimated at about 800,000 tons! The realization of this process on a large scale still offers difficulties.

If, too, the chemical industry must first take the direction that it must attain the position in which unfavorable effect will be removed from its cement production processes and oily then take up the refinement of a standard product.

Report on Recent Cement Investigation

By Prof. Dr. R. Nacken

The necessity must be emphasized, in the research upon the constitution of cement clinker, that syntheses of material must be made which will withstand any objection. A process which seems promising involves the crystallization of the calcium silicates and probably also the calcium aluminates by means of special salt fusions at high temperatures.

In examining melting point diagrams of the constituents of cement clinker it is apparent that in many cases there is agreement in the behavior of the silicic acid systems of various divalent metallic oxides, such as calcium, magnesium, barium, strontium, manganese, iron and lead. And yet it cannot always be concluded from a similarity of structural formulae what the physical-chemical behavior will be and generalizations must be cautioned against. It is characteristic, for example, that while calcium meta silicate and strontium metasilicate are completely miscible, on the other hand calcium metasilicate and barium metasilicate are in no way miscible in the crystalline state.

The investigation of the structure of important cement constituents by x-rays or by optical methods points to the same conclusion, that whether the time-consuming Roentgenography or the optical constants are used, it is essential first to work with simple pure components before it can be considered to investigate the complicated cement systems. The direction for further work will be indicated after the calculation of the characteristic lattice constants.

The cause of blowing phenomena in certain cements, a most destructive property, does not lie in a crystallizing tendency of certain new appearing double compounds and hydrates for not one such demonstrably exists. The explosive action of the so-called blowing phenomenon is purely of capillary nature. The only possibility of preventing the phenomenon consists in a very careful preparation and working up of the cements. In this way is prevented great local concentrations of chemical materials, which may be set by water, acid or similar substances.

In the discussion Prof. Kuhl declared that great caution must be used in drawing conclusions concerning barium and strontium compounds on the basis of the behavior of calcium compounds, for while doubtless many parallel phenomena do exist, it has been known since 1898 that only calcium cement hardens, the others do not. Prof. Kuhl suggested capillarity in 1912 as the cause of blowing, in any case free lime is not the cause. It is a noteworthy fact that cement cake surrounded by a steel ring does not blow, even when the steel ring is removed. On the othe. hand, cement cakes covered with lacquer or paraffin, blow.

Porous Building Materials from Cement

By Prof. Dr. Julius Meyer

The problem in the production of porous building materials from cement consists in the combination

of the advantages of cement and those of bricks with avoidance of the disadvantages of both building materials. The principal advantages consist of a very low heat and sound conductivity, of a saving in material, of a low apparent density, of a consistency permitting mailing and in simple building use.

The processes of making various porous building materials, must lend themselves to use at each building site without special devices, and using only the usual building materials—sand, cement, aggregate, etc. These conditions cannot be fulfilled if a foam is first prepared and this then hardened by treatment with cement. For use at the building site, only one process will do, the use of still plastic building material and the production of pores in it by the evolution of a gas. While there are numerous "blowing materials" they all have objections and cannot be introduced into practice. The gas former may react only with water but not with an essential ingredient of the cement, as, for example, powdered aluminum injures the product. The gas forming substance must be capable of being very finely powdered, as on it depends not only the porosity but also its insulation capacity. The reactivity of the gas former must correspond to the initial set of the building material, as otherwise either the compressive strength or the porosity suffers. After settling this and numerous other requirements a gas producer has successfully been developed with the aid of the I. G. Farbmindustrie A. G. which has the desired characteristics which also may be altered to correspond to the properties of the building material. The material is metallic calcium, which is alloyed with definite substances.

Depending upon the manner of alloying the gas evolution may be made faster or slower. The use is extremely simple in that the dry sand-cement mixture is mixed in the usual ratio up to 1:7 with the addition of certain aggregate such as coke ash, kieselgukr, wood meal, gypsum, etc., 0.1 per cent or somewhat more gas former and then water by hand or machine to a dense fluid mass, stirred and cast in forms, which are charged to 70-80 per cent.

Depending on the variety of gas former the forms are filled full after one-half to three hours when the contents harden in the usual manner. The most important characteristic of the porous product thus obtained is its apparent density, which may be varied as desired from 400 kg. to 2000 kg. per cu. meter. The density depends on the proportions in which the cement is mixed with sand, Kieselgukr, coke ash and on the amount of gas former added. Other characteristics, such as the crushing strength depend on the density, as a curve clearly shows. It appears that independent of the mortar used, that, for a definite density a maximum crushing strength cannot be exceeded. Thus no appreciable crushing strength results if the density is less than 800 kg. per cu. meter and this material is suitable only for stucco and insulators. The insulating properties against heat and sound depend mainly on the density and also upon the size of the pores. It is better the finer the pores.

Powers building material prepared in this way can be easily mailed, and serves well for light reinforced concrete construction, as the iron in it is protected against rust just as well as in heavy concrete.

Some Flood Damage

Highways and bridges in the flood districts of Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi and Louisiana were damaged to the extent of $3,949,900 by the recent overflowing of the Mississippi River, the American Road Builders' Association stated recently. Most of the roads damaged have already been repaired in some degree.

Improved highways withstood the onrush of water without serious damage, the association asserts. Roads without improvement were in many cases virtually wiped out, causing an expensive delay in traffic and curtailing the movement of necessary food and shelter supplies. Bridges were completely destroyed in sections where the foundations were not constructed to withstand the swift moving waters.

The damage to public highways and bridges has been estimated at $2,738,100, and the damage to privately owned roads and bridges at $1,211,800. The loss constituted less than 1.7 per cent of the estimated flood losses of $236,334,414 as compiled by the Port of New Orleans. The most serious loss in the flood was that of growing or newly harvested crops which totalled approximately $73,541,000.

The American Road Builders' Association urged the immediate construction of an adequate highway system designed to withstand the maximum flood waters in those sections subject to overflow. The existence of these roads, it was stated, will facilitate the salvage of personal property, protect human life, and permit speedy reconstruction of damaged areas.

Good Roads Save Lives

Good roads in the Florida counties struck by the hurricane last year were opened for motor travel within a few hours after the storm had subsided. The quick movement of first aid supplies and rations over these roads unquestionably was responsible for the saving of many lives.

Harry N. Clark, of the Dolomite Products Company, Rochester, New York, writes: "I feel quite confident the Pit and Quarry Hand Book will prove invaluable."

DISCUSSING THE BUREAU OF PUBLIC ROADS REPORT OF NEW JERSEY COMPARATIVE TESTS ON CRUSHED STONE AND GRAVEL CONCRETE

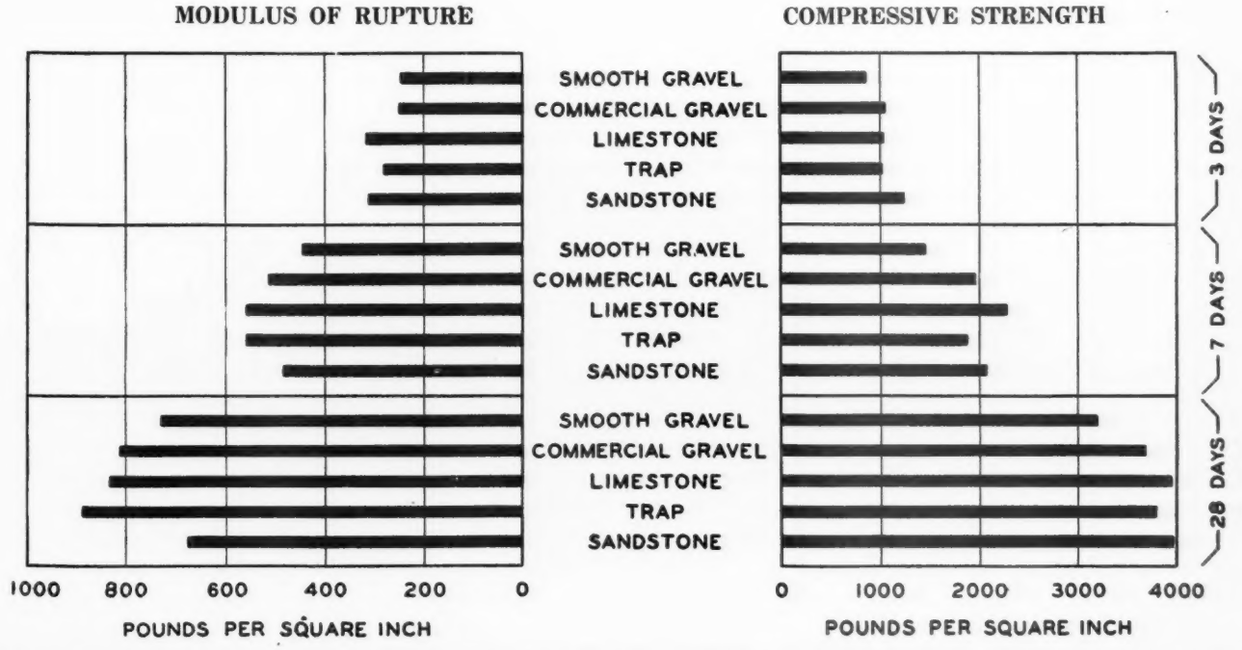
By A. T. Goldbeck
Director, Bureau of Engineering, N. C. S. A.

CONSIDERABLE interest has been shown over the New Jersey comparative tests on crushed stone and gravel concrete. We have published the report on these tests and a discussion by Stanton Walker, Director, Engineering and Research Division, National Sand and Gravel Association. Here we present a discussion by A. T. Goldbeck taken from the March *Crushed Stone Journal*, the official publication of the National Crushed Stone Association.

The tests described in the report of cooperative tests conducted by the New Jersey State Highway Commission and the U. S. Bureau of Public Roads (published in Pit and Quarry, April 11, 1928, and discussed by Stanton Walker in Pit and Quarry, March 28, 1928,) are of very great significance, primarily because they show the influence which the coarse aggregate may have on the kind of strength which is so desirable for concrete road construction, namely, transverse strength. It is a fact that high compressive strength may be obtained even with the use of comparatively inferior coarse aggregates, but apparently the transverse strength of concrete is influenced by the characteristics of the coarse aggregates. For those who are not informed on the importance of high resistance to cross-bending or to direct tension in concrete for highway construction, it will not be amiss to enter into a brief discussion of this matter.

Concrete is not the extremely rigid material which its appearance indicates. It can be bent, stretched or compressed, and just as long as it is not subjected to excessive stretching, bending or compression, apparently it remains in its original condition, free from tension cracks or other signs of failure. On the other hand, too much stretching of the concrete, whether by direct forces or by the bending of the slab under traffic will produce a tension failure as evidenced by cracking. If too high a compressive force is created the usual external evidence is shattering of the concrete. Failure by shear is still another form of failure of concrete which, in general does not seem to be particularly important in concrete roads. In order to understand the relative importance of tension, cross bending resistance and compressive resistance of concrete, let us give some thought to the forces to which a concrete road slab is subjected.

Soon after concrete is laid and has hardened it is cured under moist conditions. Since moisture keeps it swollen or expanded, it is placed under slight compression and would remain so as long as it is wet were it not for variations in temperature. At night the temperature generally falls and contraction of the concrete results and tension may be



Redrawn from Figure 1 in C. F. Lang's paper, "Effect of Shape and Character of Coarse Aggregate on Strength of Concrete" published in "Concrete" March, 1928

produced of high enough value to crack the slab transversely, perhaps one day after the concrete is laid. When the curing period has ended the concrete dries out, and since moisture has somewhat the same effect on concrete as on timber, it shrinks and in so doing draws itself over the subgrade. As the slab can not readily slide, its motion is resisted by forces of friction and tension is set up, tending to crack the slab transversely. It is thus evident that it is desirable to have high resistance to tension in the early stages of hardening of concrete used for concrete surfaces. Should expansion take place due to a rise in temperature, compressive stress will be created, but this stress can not be great during the period when the concrete is shrinking and is not important in the early stages of hardening nor even in the later stages if the road is properly designed.

When the road is opened to traffic the heavy wheel loads cause bending of the slab. If the wheel is placed at a corner formed by a transverse joint and the side of the slab, that corner is bent down and, as a result of the bending, tension is produced in the top of the slab and compression in the bottom. These tensile and compressive stresses are practically of identical amounts as shown by actual measurement. This stress condition is shown in Figure 1-A.

When the wheel load is placed at the edge of the slab at some distance from a corner, the slab is bent as shown in Figure 1-B. In this case horizontal compressive stress is created at the top of the slab and horizontal compressive stress is created at the top of the slab and horizontal tension at the bottom. Again, the tension is equal to the compression and this is a very important fact in demonstration of the great significance of the transverse test for concrete for use in highways.

Ordinarily, road concrete has a compressive resistance of 3,500 pounds per square inch, but it has a tensile resistance in bending of perhaps only 1/5 to 1/7 of this amount. It follows, then that since the bending creates horizontal compressive and tensile stresses of like amount, distributed as shown in Figures 1-A and 1-B, failure in bending is due to a failure of the concrete on the tension side and not on the compression side. Concrete is amply strong in compression but is very weak in tension.

The compressive stresses to which concrete in concrete roads may be subjected are produced, first, by the actual vertical pressure under wheel loads; second, by the compressive stresses due to bending; and, third, by horizontal expansion of the slab due to moisture and temperature. The vertical compressive stress due to wheel loads can be dismissed immediately for it is always of negligible amount. That this statement is true is shown by the fact that truck wheel-load pressures seldom exceed 800 pounds per inch of width of tire and the length of support due to flattening of the tire is often 12 to 15 inches. Horizontal compressive stresses due to bending, as has just been pointed out, may be ignored because a bending failure is a failure due to the weakness of concrete in tension and not in compression. Under the action of expansion forces it is possible to produce high compressive stresses, the effect of which is to buckle the slab and cause it to rise from the subgrade, sometimes accompanied by shattering of the concrete. The slab acts much like a long column and buckling is accompanied by a failure of the concrete in tension. The creation of buckling stresses is greatly reduced by the provision of proper room for expansion through the use of expansion joints at intervals.

The kind of failure to be feared most in concrete pavements is excessive cracking, which can only be produced through a failure of the concrete in tension due either to direct forces, or to bending. Of the two, the bending effects of traffic and of other causes, such as subgrade settlement, are most important.

If the road is reinforced with steel the above statements are still valid, for the steel, as can be shown by analysis, does not become fully effective until after cracking takes place. Its function is primarily to prevent the cracks from spreading.

The integrity of a concrete road is thus seen to be largely dependent upon the resistance offered by the concrete to bending but there is one pecu-

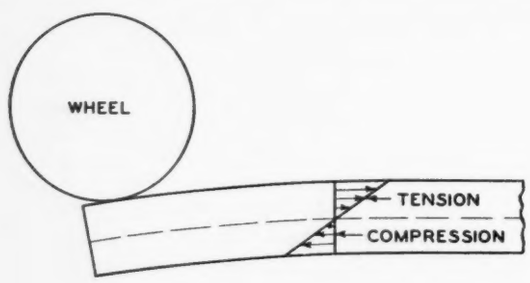


FIG. 1A

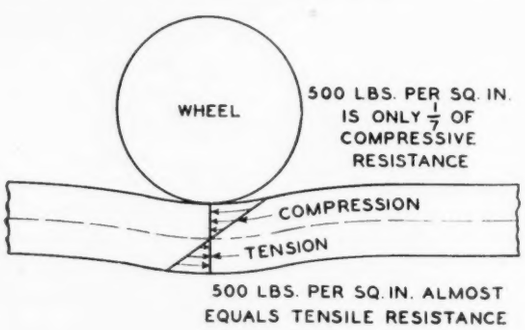

WHEEL
500 LBS. PER SQ. IN. IS ONLY 1/7 OF COMPRESSIVE RESISTANCE
COMPRESSION
TENSION
500 LBS. PER SQ. IN. ALMOST EQUALS TENSILE RESISTANCE

FIG. 1B

Bending Stresses Due to Wheel Loads—Showing that a Bending Failure of Concrete Always Results from a Failure of the Concrete in Tension

liarity about concrete road design which is not now fully realized by many engineers, namely, that under heavy frequent traffic the bending stresses very nearly approach the resistance of the concrete to repeated bending. In other words, concrete roads have a very small factor of safety against repeated bending stresses and even a slight lack of bending resistance may result in rapid cracking and a slight excess may greatly delay or even prevent excessive cracking. The very fact that it is economical to design concrete roads up to the very limit of safety as far as cross-bending resistance is concerned, shows very forcibly the importance of using a concrete having as high a bending resistance as possible. Such concrete will also have a sufficiently high compressive resistance but the converse is not always true. Many states have already recognized the bending test for concrete as being of very much greater significance than the compressive test and others are following.

The two materials which are compared in this test are both of very high quality in their respective types. The crushed stone is a trap rock of great hardness and toughness having a percentage of wear of 2.0. The gravel in the past has shown an abrasion loss of approximately 6 per cent in the Gravel Abrasion Test. This percentage shows the gravel to be of high quality. It consists of rounded fragments of sandstone, quartz and rhyolite. The trap rock is extremely angular in shape, and, in consequence, the crushed stone has a higher percentage of voids than the gravel in samples having like mechanical analyses. Because of this fact, as pointed out by Mr. Jackson, the stone concrete showed a lower yield than the gravel concrete, per bag of cement, when identical arbitrary proportions, such as 1:1¾:3½, are used. In the stone concrete more of the mortar is required to fill the voids than in the gravel concrete and less of it is available for spreading the stone. The tests show that at 28 days, in the 1:1¾:3½ concrete, the stone concrete averaged 12.8 per cent higher in modulus of rupture than the gravel concrete, and at 6 months was still higher to the extent of 13.2 per cent, an average of approximately 13 per cent. The compressive strengths of the stone and gravel concrete at 28 days and 6 months were practically identical and both were of high value.

In the mixes in which the ratio of sand to coarse aggregate was 33:67, 36:64 and 40:60, the average modulus of the stone concrete was still considerably higher than that of the gravel concrete. The important point to notice, however, is that in 49 of the 52 comparisons for modulus of rupture, the stone tested higher than the gravel and averaged 12 per cent higher. The gradings of coarse aggregates used covered a wide range including those acceptable and those not acceptable to the state.

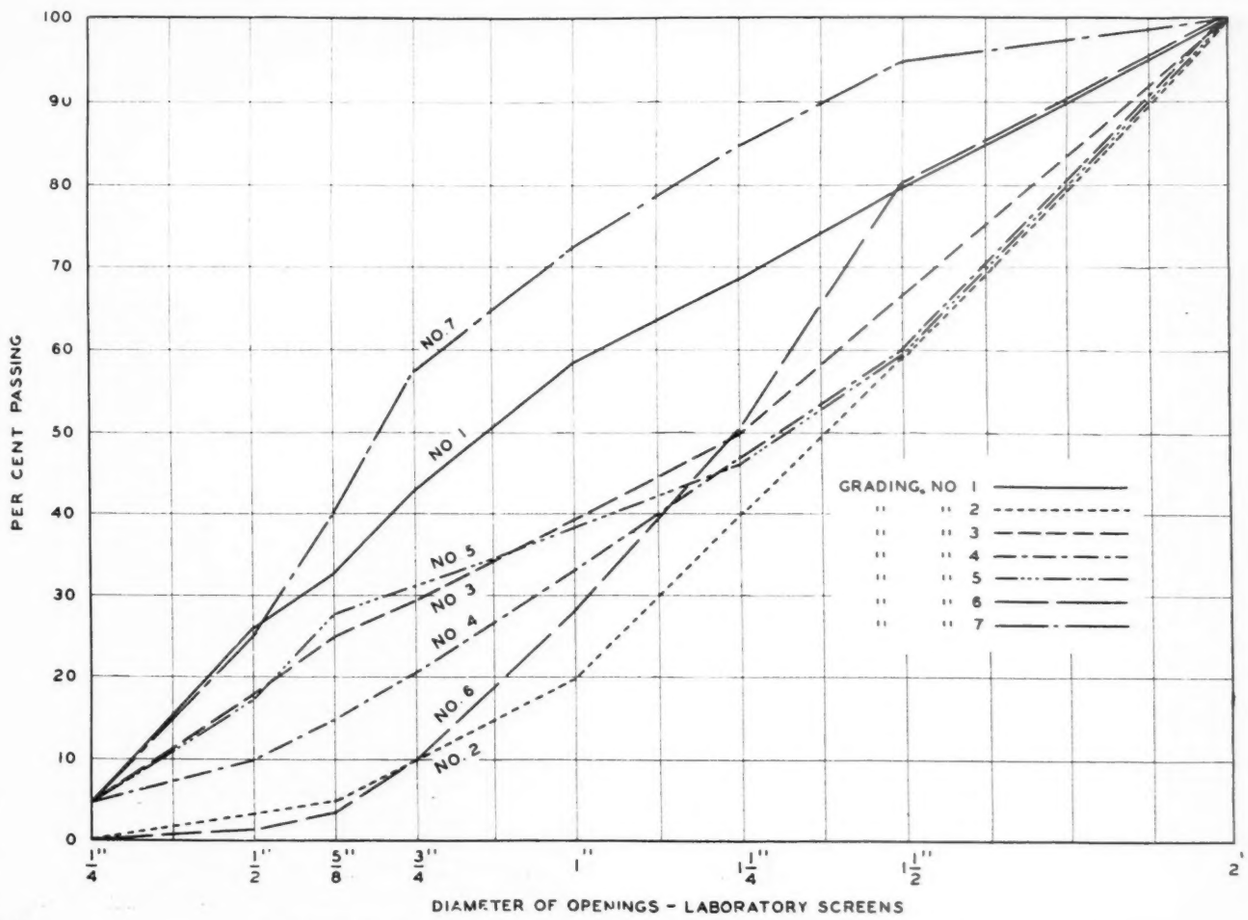


Fig. 2—Mechanical Analyses of Coarse Aggregates used in Bound Brook Tests

Figure 3—Crushed Stone Concrete (2 per cent wear)

The results could hardly be more conclusive for the particular materials tested.

It has been demonstrated, in connection with the two particular coarse aggregates under test, that the characteristics of the coarse aggregate have a decided influence on the cross-breaking strength of concrete. The difference in cross-breaking strengths, amounting to 12 per cent, is such that a gravel slab should be 6 per cent greater in thickness than a stone slab, or approximately ½ inch more gravel concrete should be required to produce the same slab strength that will result from the use of stone concrete.

It is well to again emphasize the influence which the modulus of rupture of concrete has on the life of a concrete pavement. It has been generally accepted, as the result of extensive field and laboratory investigations, that a concrete road should be designed by the use of the following formula:

$$D = \sqrt{\frac{3W}{S}}$$

Where D = Thickness of the slab at the edge
W = Maximum wheel load to be applied
S = One-half the modulus of rupture

The value for S is taken at ½ the modulus of rupture because laboratory tests have shown that if the working stress S exceeds approximately 55 per cent of the modulus of rupture, the concrete will fail in a comparatively few applications of load due to fatigue, while if the stress is kept below that figure the load may be applied millions of times and fatigue is long delayed.

Let it be assumed that the modulus of rupture of the concrete is equal to the average value of the stone concrete at 28 days, namely, 570 pounds per square inch. The working stress would then be 285 pounds per square inch for use in the above formula. The modulus of rupture of the gravel concrete was only 505 pounds per square inch at 28 days and a stress of 285 pounds per square inch is 56-3 per cent of this modulus of rupture while the same stress of 285 pounds per square inch is only 50 per cent of the modulus of rupture of the stone concrete. As 55 per cent of the modulus of rupture seems to approximate the "dead line" beyond which the stress should not extend to prevent fatigue, it is well demonstrated how very important seemingly slight differences in modulus of rupture in concrete can be. The above assumed gravel concrete road having the same thickness as the stone concrete road is apt to be unsafe against cracking due to fatigue while the stone concrete road should remain uncracked. This is simply another way of stating that the fatigue limit of this particular gravel concrete will be reached sooner than the fatigue limit of the stone concrete because of its lower modulus of rupture.

It is entirely logical, therefore, that one of two things be done to improve the strength of the gravel concrete road: (1) Increase its thickness so that its bending stresses will be decreased to a value not in excess of 50 per cent of its modulus of rupture. (2) Change the proportions of the gravel concrete, requiring more cement so as to increase its modulus of rupture. The Bureau of Public Roads-New Jersey Tests do not show what change in proportions might be made in the gravel concrete to make it of equal cross-bending strength as the stone concrete although they do give an answer to the question of how much extra thickness of gravel concrete is necessary to make it of the same slab strength when crushed stone is used.

In order to get an answer to the second question, namely, that of what proportions of gravel concrete will give approximately the same cross-bending resistance as given proportions of stone con-

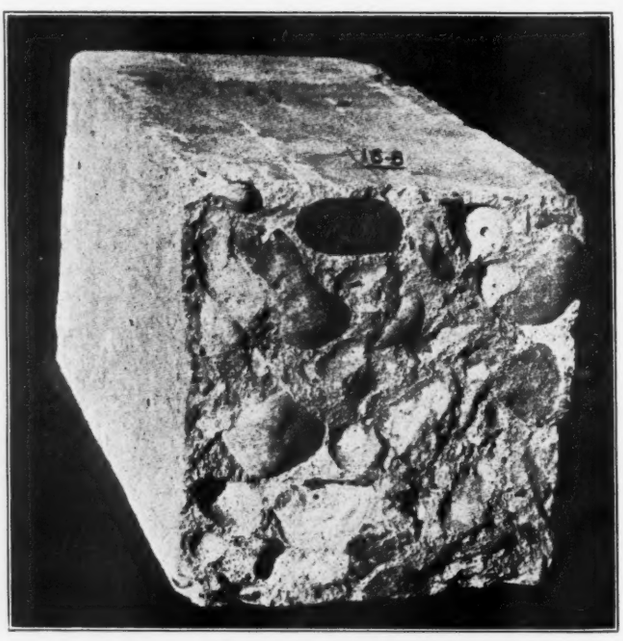


Fig. 4—Gravel Concrete (6 per cent wear)

crete the writer directed a short series of tests at the plant of one of the stone producers of New Jersey at Bound Brook. Identically the same coarse aggregates were used in these tests as in the Bureau of Public Roads-New Jersey State Highway Department tests but, in addition, there were also included a sample of dolomite of very high grade and also a sample of gravel of very low resistance to wear in the Gravel Abrasion Test, approximating 25 to 30 per cent loss. Concrete was made from these respective coarse aggregates using the same fine aggregate in all cases. The proportions and the gradation of the coarse aggregates were varied and the concrete mixes were designed to produce concrete having pre-determined amounts of cement per cubic yard. In some cases the proportions were made on the basis of dry, rodded volumes according to A. S. T. M. methods for determining weight per cubic foot, and, in other cases, the proportions were in terms of loose volume. Beams were made 6 inches in cross-section and 30 inches long and were broken as cantilevers at the end of 14 and 28 days. The aggregate gradations used are shown graphically in Figure 2. These gradations were purposely made to cover the range of gradings permitted by the New Jersey State Highway Department specifications. Crushing strength tests were also made on the pieces resulting from the beam tests. In general, all of the aggregates show high compressive strength

TABLE I.

BOUND BROOK TESTS

Mix No.	Proportions	Bags	Grading	Method	28 Day Tests Compressive strength lbs. per sq. in.	Modulus of rupture lbs. per sq. in.
STONE (Trap rock and dolomite)						
27	1:1.70:3.67	6.0	5	A.S.T.M.	2866	560
11	1:1.78:3.67	6.0	4	"	3127	639
14	1:2:4	5.6	4	"	3883	650
12	1:1.74:3.67	6.0	4	"	3453	666
20	1:1.75:3.5	6.17	4	"	3343	678
4	1:1.79:3.5	6.3	2	"	3340	683
26	1:1.53:3.5	6.3	5	"	3516	684
6	1:1.65:3.5	6.3	4	"	3750	695
1	1:1.67:3.5	6.3	1	"	4141	708
28	1:1.76:3.5	6.3	6	"	3212	712
5	1:1.64:3.5	6.3	3	"	3786	712
15	1:2:4	5.56	4	"	4230	727
8	1:1.56:3.5	6.3	4	"	3433	770
	Average	6.1			Average 3544	Average 683
CONCRETE GRAVEL (6% wear, Gravel Abrasion Test)						
2	1:1.36:3.5	6.3	1	A.S.T.M.	3995	592
7	1:1.23:3.5	6.3	4	"	3718	609
16	1:1.75:3.5	5.87	4	"	3373	621
25	1:1.23:3.5	6.3	5	"	3940	652
3	1:1.38:3.5	6.3	2	"	3940	672
	Average	6.21			Average 3793	Average 629
¾-INCH GRAVEL (25 to 30% wear, Gravel Abrasion Test)						
10	1:1.15:3.5	6.3	7	A.S.T.M.	3201	495
19	1:1.5:3	6.48	7	"	3866	518
18	1:1.75:3.5	5.82	7	"	3767	593
13	1:0.85:3.15	7.0	7	"	4600	603
	Average	6.40			Average 3878	Average 552

COMPARISON OF AVERAGE VALUES FOR MODULUS OF RUPTURE AT 28 DAYS (A. S. T. M. METHODS)

Type of aggregate	Modulus of rupture	Cement Content, bags	Bags of Cement per 100 lbs. modulus of rupture	Ratio	Probable No. bags of cement required for equal modulus of rupture
Stone	683	6.10	0.892	1.00	6.0
Concrete Gravel	629	6.21	0.985	1.10	6.6
¾-inch Gravel	552	6.40	1.16	1.30	7.8

COMPARISON OF AVERAGE VALUES FOR COMPRESSIVE STRENGTH AT 28 DAYS (A. S. T. M. METHODS)

Type of Aggregate	Compressive strength	Cement content, bags	Bags of cement per 1,000 lbs. compressive strength	Probable ratio of cement required for equal compressive strengths
Stone	3544	6.10	1.72	1.05
Concrete Gravel	3793	6.21	1.64	1.00
¾-inch Gravel	3878	6.40	1.65	1.00

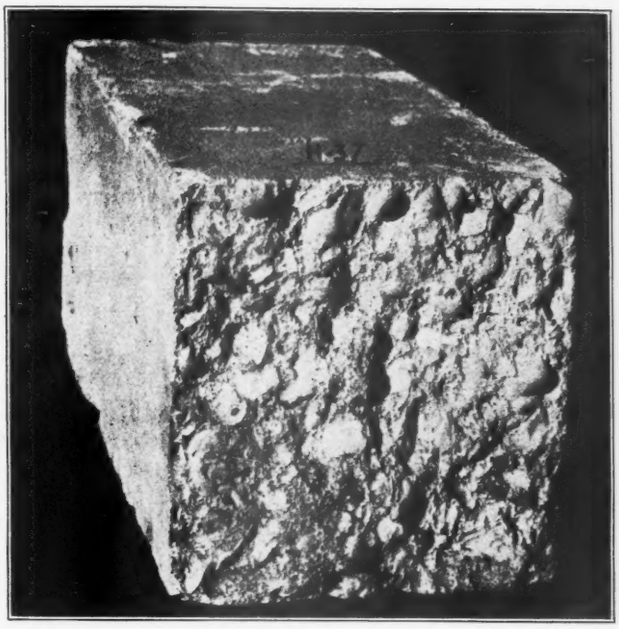


Fig. 5.—Gravel Concrete (25 to 30 per cent wear)

irrespective of quality of type. The differences in crushing strength are not significant and all crushing strengths were well above those ordinarily required for concrete roads. The cross-bending strengths were quite different in value, depending upon the coarse aggregates as shown in Table 1. The trap rock and dolomite are grouped together. The so-called concrete gravel having six per cent wear is placed in the middle group and the ¾ inch gravel, having 25 to 30 per cent wear, in the bottom group. It is quite striking that the modulus of rupture of the stone concrete is much higher than of the gravel concrete and very much higher than the ¾ inch, or poor gravel, concrete.

Each result is the average of three cross-bending tests. Comparison of individual mixes is probably not warranted in these tests but the average results are significant. It is to be noted that, although the stone concretes tested had an average cement content of only 6.1 bags per cubic yard as against 6.21 and 6.40 for the good gravel and poor gravel respectively, the modulus of rupture of the stone concrete was 53 pounds, or 8.4 per cent higher than the gravel concrete, and 130 pounds of 23.5 per cent higher than the poor gravel concrete. In other words, the stone concrete had a higher modulus of rupture than the gravel concrete even with a small content of cement per cubic yard. These tests in their general results corroborate the Bureau of Public Roads-New Jersey State Highway Department Tests but they go further in showing that a change of proportions is warranted to produce road slabs of equal strength. They show that more cement is required in gravel than in the stone concrete instead of less cement as required by the time-honored arbitrary proportion method in which the proportions are stated as 1:1¾:3½, etc. The probabilities are, judging from

the results obtained, that 10 per cent more cement is necessary in the gravel concrete of high quality than in the crushed stone concrete and perhaps as much as 30 per cent more cement should be used in the concrete containing the poor gravel than in that containing the crushed stone in order that the slab strengths may be alike in all cases. The Bound Brook tests show that there is no basis for adhering to the same proportions of mortar when changing the proportions of concrete to suit different coarse aggregates, for it is shown that the stone concrete is stronger than the gravel concrete even though its mortar is leaner. It may be well in fact to add to it in the gravel concrete to make for workability in the former and prevent over-sanding in the latter.

No doubt the differences in cross-breaking results in part are due to the shape of the fragments, to the roughness of their surfaces, and to the strength of the fragments. It seems entirely reasonable that smoothness of surface must have influence on the cross-breaking resistance of concrete, because the adhesion of the mortar to the surface is probably aided when the surfaces of the coarse aggregates are rough in much the same way as the bond resistance is increased mechanically in a deformed reinforcing bar as compared with a smooth reinforcing bar. It also seems reasonable that angularity of particle may be of some assistance in creating higher tensile resistance because of the greater interlocking effect thereby produced. The strength of the fragments probably also has influence because the fragments are placed in tension. At any rate, in the broken cross-bending specimens it was noticeable that there was better bond between the stone and the mortar as indicated by the fact that few of the gravel particles were broken. On the other hand, there were more fragments broken in the soft gravel specimens than occurred in beams containing the gravel of high quality. These indications are somewhat imperfectly illustrated in Figures 3, 4, and 5.

Some light is thrown on the question of influence of shape of particle and characteristics of surface by tests recently published in the March, 1928 issue of Concrete by F. C. Lang, Engineer of Tests and Inspection, Minnesota Department of Highways. A diagram of the results reproduced from Mr. Lang's article is shown in Figure 6. In these tests the aggregates compared were as follows:

No. 1. A smooth water-worn gravel largely composed of igneous rocks from northern Minnesota. All flat, elongated and broken pieces were picked out by hand.

No. 2. An ordinary commercial gravel containing crushed oversize from St. Paul, Minn.

No. 3. A crushed limestone.

No. 4. A crushed trap rock.

No 5. A crushed sandstone. Per cent loss in abrasion test, 11.1.

One-half hour absorption, 3.13 per cent.

The tests were made using a constant water-cement ratio. It is apparent that the angularity or smoothness of surface, or perhaps their combination, have influenced the cross-breaking resistance of the concrete. Both the limestone and the trap rock have a higher modulus of rupture than the rounded smooth gravel, to the extent of approximately 23 per cent in the case of the trap rock and over 11 per cent in the case of the limestone. When compared with the commercial gravel containing, in part, crushed particles having rough and angular surfaces, the differences in cross-breaking strength were not so apparent. The tests, however, corroborate in a general way the tests previously cited and certainly show that shape of particle and smoothness of particle have influence on the cross-breaking resistance of concrete. The sandstone had a low cross-breaking resistance but it was a sandstone of very poor quality as determined by the Deval Abrasion Test. Practically no states will allow a stone having a Deval Abrasion loss in excess of 7 per cent to be used as a coarse aggregate in concrete road construction, whereas, the sandstone tested had an abrasion loss of 11.1 per cent. Apparently, then the quality of the aggregate, as determined by the abrasion test, influenced the cross-breaking resistance of the concrete and the indications are also very strong that in the Bound Brook, New Jersey, tests previously cited, the same remark might be made with respect to the two gravels tested. The gravel having 25 to 30 per cent loss was much lower in cross-breaking strength than the gravel having only 6 per cent loss and this was true notwithstanding the fact that more cement was used per cubic yard with the poor gravel than with the good gravel. The comparison unfortunately is somewhat clouded because the soft gravel was also smaller in size.

It should not be inferred from the above cited tests that all crushed stone will invariably test higher in cross-breaking strength than all gravel. The Minnesota crushed sandstone illustrates this point. It is very well demonstrated, however, that all coarse aggregates do not produce concrete having like concrete road making qualities and it is thoroughly shown that it is not safe to proceed on that assumption in using aggregates in concrete roads.

When a concrete road is built of a given thickness it is assumed that it is capable of carrying a wheel load of a given maximum weight. As pointed out, the factor of safety of a concrete road, of necessity and for the sake of economy, must necessarily be made low. As a result, concretes having a comparatively low modulus of rupture are apt to fail while concretes having a high

(*Continued on page 86*)

DUST COLLECTORS IN THE PIT AND QUARRY INDUSTRIES

Part Two

By H. W. Munday

PART one of this article appeared in the April 11th issue. Three of the four types of dust collectors with which this article is concerned were discussed in part one i. e. water sprays, centrifugal and electrical precipitation. The fourth type i. e. cloth filters is discussed here in part two and some additional data is also presented on electrical precipitation.

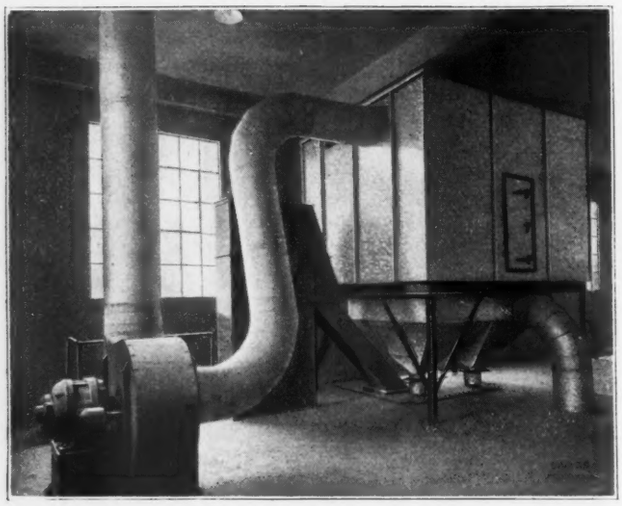
In the electrical precipitation dust collecting systems the dust laden air is injected into a high tension electric field. Both direct and alternating current is used. There is a difference in action however. When direct current is used all particles become charged and are driven to the collecting electrode which is grounded. The dust particles are dislodged from this collecting electrode by means of mechanical rapping devices and settle in a hopper placed below the filter. This collected dust is then removed by means of screw conveyors, piping with suction fans, belt conveyors, etc. The clean air or gases pass on through the apparatus unaffected. It may seem strange that the dust falling from the collecting electrode is not carried on by the air current. This is explained because the dust gathered by the collecting electrode forms lumps which produce very little dust in dropping. Whatever little dust does escape is however merely recovered again by the same process. When alternating current is used, the coarse particles are removed as effectively as with direct current but the fine particles are not removed as effectively.

It is significant that, in the electrical precipitation method, the dust laden air or gases are passed through the apparatus in a parallel direction to the electrodes so that no losses result from a change in the direction of flow. The direction of flow of the dust laden air or gases may be vertical or horizontal. In the vertical type up or down draft may be used.

Relatively high voltage and very small amperage is used in the electrical precipitation systems. With the very low current, there is no real danger even with the high tension. Short circuits are of little consequence.

They are entirely safe to operate particularly if the discharge electrode system is completely enclosed and all exposed parts of the rest of the structure grounded. Protection devices can also be had

Here Is a Cement Plant That Is Protected from Dust



A Cloth Filter Dust Collector

so that operators cannot have access to the discharge electrode system without this system being automatically grounded.

In the installations of this type in the pit and quarry industries several types are found which vary mainly in the type of collecting electrode i. e. pipes, rods, plates, screens, etc. The type to be used is decided by the condition of the specific problem, the character and volume of the gases to be treated, nature of the dust, available space for installation, etc. When large volumes of air or gas are treated, the Cottrell precipitators are built in separate units both for electrical and mechanical reasons. The size of units may vary from one suitable to clean 1,000 cubic feet per minute to one handling 50,000 or more cubic feet per minute. The manufacturers of the Cottrell system recommend two or more units because of greater flexibility. The electrical precipitators are usually built of steel although where the gases are corrosive lead or other corrosion resistant materials are used. In other cases only the electrodes and their supports are made of metal while the housing is built of brick or concrete.

There are a number of installations of the electrical precipitation method in this country. At one cement plant using kilns 8 by 125 feet, 15 tons of dust are being collected per kiln every 24 hours at an efficiency averaging 98 per cent. In another cement plant, the kiln gases are cooled and humified in spray chambers where the coarse dust is also removed. The potash fumes and fine dust enter an electrical precipitator and are collected in the form of a big concentrated potash material, about 75 per cent potassium sulfate. The Universal Portland Cement Company has an installation at the Buffington plant handling more than one million cubic feet per minute at a temperature from 500 to 600 degrees F. Gases from the dry process kilns, raw mills and coal plants are cleaned.

Cloth Filters

The principle of cloth filtration of dust laden air has been applied by manufacturers of dust collecting systems to many plants in the pit and quarry industries.

Two general types are in use. One type is built up of parallel cloth screens rigidly fastened on frames with the dust discharged by a mechanical rapping system. The other type uses a number of cloth cylindrical bags usually rigidly at the bottom and suspended from the top with the dust discharged by vibration at the top or rapping of the bags.

In general the cloth filter type of dust collector consists of a number of rectangular frames on which the screen cloth is stretched. These are arranged to form a continuous zig zag partition dividing into two parts the steel case of the machine. The dusty laden air usually enters anywhere in the lower part of the collector and is admitted to one of these spaces while filtered air is drawn from the other by a fan. Part of the dust falls immediately into the hopper while the finer dust is carried with the air against the many screens made of specially woven cloth. The air continues through by suction of the exhaust fan while the dust adheres to the cloth. Baffle plates are usually employed to prevent destruction of the screens by the impact. The screen frames are shaken by a mechanical device installed for such purpose. This shaking is not violent and is only done once a day usually. The screen cloth lasts several years. The fan is on the suction side of the unit and is not subject to abrasion from dust.

These cloth screens can be cleaned in some types by reversing the air current for a brief period of about a minute without interfering with the dust collecting operation. The clean air that is generally exhausted from the exhaust fans is blown back into the collector and through the clean side of the cloth screens blowing off the collected dust on the dirty side of the cloth.

Care should be exercised in selecting the size of unit. Too small a unit will mean failure. The size of the exhaust fans should be sufficient for the work required.

In conclusion, there are one or two points that should be considered by those contemplating dust collector installations.

First, due regard should be given to the cutting effects of the dust particles traveling at high velocity through the ducts. This is particularly noticeable at elbows and other places where the pipe changes direction, and the seriousness of the trouble depends on the nature of the dust being handled. It is not important with raw material dust, except perhaps where slag is used, because ordinary limestone and clay or shale are not markedly abrasive. Cement dust is another mat-

ter. Bends in the dust piping back of Bates packers have been cut through in six weeks, and the straight pipe failed later. The air velocity must be kept high enough to carry along the largest pieces that will be picked up. The coarser particles of cement are very hard and gritty, and the effect on the pipe is that of a sand blast. The pipe, and especially the elbows and bends should be made of much heavier material than would at first seem necessary, and the bends could well be reinforced along the outer side.

Second, the gases from dryers are always heavily laden with moisture and are sometimes saturated with it. In cold weather they will precipitate water on almost everything they touch. They can be treated in cyclones kept at a temperature above the dew point of the gas, and if complete purification is desired, the last step may be a water spray, the collected mud being discarded. In the case of coal dryers the same arrangement can be used, but it must always be remembered that a cyclone handling dry coal dust is a potential source of spontaneous combustion and explosion.

Third, in collecting dust from a raw grinding department due regard should be had to the water vapor present. The rock and clay or shale are never perfectly dried, and much of the residual moisture is set free when they are pulverized. The moisture and dust-laden air may be treated in a heated cyclone, just as dryer gases are handled; but as the system may involve several suction pipes of varying lengths, it may be necessary to keep them warm also by covering them with heat-insulated material or by enclosing them in a box or jacket with a steam pipe.

Fourth, in many mills the clinker is more or less damp when ground. This may be due to the sprinkling it received when it came from the kilns or it may have taken up water in an outside storage. Whatever the source, the dust arising during grinding will carry a good deal of vapor which will, especially in cold weather, condense as it cools. The cement dust that settles with it will then set to a hard mass. If such dust is passing through an air filter, there is danger that the cloth screens will become coated with set cement and their value permanently destroyed. This could be prevented by keeping the dust air at all times well above its dew point, and to insure freedom from condensation, all dust pipes and the case of the filter should be kept at this same temperature or higher. This is a vital point in collecting clinker mill dust.

Fifth, it may seem desirable to collect the dust from several widely separated points in a department, involving long gathering pipes. The air velocity in these must be high enough to prevent settling, otherwise choking will eventually occur. As before mentioned, condensation in these pipes must also be guarded against.

Sixth, when a dust collector is in use it would seem that vacuum sweeping is logically the next step, for it will do far more efficient cleaning than brooms. If the collector does not produce sufficient suction to do good sweeping a small high speed fan could be used for this purpose only, discharging its dust into the collector. The only other apparatus needed would be the piping and hose and fan-shaped suction nozzle like that supplied with many vacuum cleaners.

Dust collecting in the pit and quarry industries is only in its infancy, and while it offers some difficult problems, our engineers can work out a complete solution just as they have in so many other cases. It is the writer's belief that in a very few years the manufacture of cement, etc., will be just as clean as any other of our major industries.

Treatment of Potash Ores

A detailed study of drill cores obtained from potash test well No. 1, recently drilled in New Mexico, is being made at the Non-metallic Minerals Experiment Station of the United States Bureau of Mines at New Brunswick, New Jersey. Laboratory tests have been made of material from a promising bed of sylvinite. The well-known German method of fractional crystallization can evidently be employed with success on the American salts. The process of recovery of sylvite, KCl, from beds of this character is probably simple, and can readily be worked out. Work is now being done on design of a plant for the above process, and on the approximate cost of potash concentration. The mineral polyhalite is abundant in the cores received. A study of its possible utilization will be undertaken. The insolubility of polyhalite and the presence of magnesium in it renders it difficult to treat. It is regarded as waste material in Europe.

Standardize County Road Building

Thomas J. Wasser, president of the County Officials' Division of the American Road Builders' Association, has invited all county highway officials of the nation to join in a movement for the standardization of county road building methods. The standardization will be accomplished through committees selected from the membership of the division. The next meeting will be held May 11, in Washington, D. C.

Great Service Here

Henry P. Lange, general manager of the Queen City Crushed Stone and Sand Company, Cincinnati, Ohio, writes: "This will acknowledge receipt of your 1928 Pit and Quarry Hand Book. We find this book to be of great service to us and appreciate it very much."

(Continued from page 82)

modulus of rupture may be perfectly satisfactory. In the light of our present knowledge the logical procedure is to recognize these differences in coarse aggregates and by means of cross-breaking tests determine what changes in road design should be required so that road slabs might have equal capacity for carrying the maximum loads for which they are intended.

County Organization

By R. B. Preston

Until just a few years ago the roads of practically all the counties were the responsibility of Boards of Supervisors, or County Commissioners. A county was usually subdivided into several units known as districts or townships. Almost invariably each district would plan and act absolutely independently of its fellow districts.

The reign of this misplaced authority under the old "supervisor system" in Norfolk County, Virginia, ended in 1914, at which time it had miles of roadways in an indescribably bad condition. There were ten miles of old wooden bridges over wide streams, all of which might well have been condemned. Money had been spent, considerable amounts of it each year, but the old "Pork Barrel" was all we had to show for it. A law was passed taking out of the hands of the supervisors all authority in connection with the construction, maintenance and control of the county highway system, with the end in view that authority should be centralized and responsibility properly placed. Under this law the court was empowered and directed to appoint a County Road Commission, and while there are six geographical districts in the county only three constituted this Commission, one of whom acts as chairman, another as secretary.

It was obvious that the county could not at that time operate on a pay-as-you-go plan, because we had no roads built as a beginning of our system, and in order to get the people out of the mud quickly it was necessary. We considered the "mud tax" of a much more serious nature than the interest on bonds, and a small bond issue of $250,000 was authorized for the purpose of buying and building the toll roads of the county.

Besides owning its source of stone supply the county owns a considerable road equipment. We do all of our own surface treatments, and in cases, particularly during the war period, and just after, where we considered bids excessive on concrete, asphaltic macadam, surface treated macadam, etc., we assumed the contracts, and did the construction effecting considerable saving of funds.

In this county organization we had a department to make surveys on State Aid Work, submit plans to the Highway Commission of the State, and when approved received credit for forthcoming State aid. In the past few years direct State Aid has been discontinued in Virginia, and the counties receive a pro-rata share of tax levied as a State wide charge on gas.

The authority is vested in the Board of Supervisors to fix the levy and secure funds which are turned over to, and disbursed by, the Commission. The Supervisors being in the nature of the producer of funds—the Road Commission the operator, or constructor.

The clerical force consists of a bookkeeper and stenographer, the engineer attends to all correspondence, and between meetings the major portion of the administrative work of the Commission. Each year the books and accounts of the Commission are checked by a certified public accountant, who prepares a report, setting forth all the receipts and disbursements of the Commission in the previous year, charging each road or bridge, by name or number, with funds allocated to it for construction and maintenance.

The Norfolk County organization consists of the Road Commission, three members at nominal salaries; office force, as described above; engineer, two assistants, and such additional engineering forces as commensurate with the work; maintenance crew, hard surfaces; surfacing crew, with oiling equipment; district crews, on soil roads, drainage; bridge repair crew, also employed in drainage installation; floating crew, to cover emergencies; repair shop, one head mechanic and helpers to repair trucks, rollers, sweepers and other machinery, and to inspect, grease and keep in condition draw bridges; and eight bridge tenders, operating draw spans over navigable waters.

In 1914 not one mile of decent roadway existed in Norfolk County, while in 1927, we have approximately three hundred miles of hard surfaced roads, the bridges are of concrete or heavy creosoted material, our taxes are reasonable, and our people are prosperous and happy.

*Abstract of paper presented to the American Road Congress, Cleveland, Ohio, January 11, 1928.

Call Road Builders to Meet

The annual meeting of the American Road Builders' Association has been called by President Charles M. Babcock for Washington, D. C. on May 11th. Road officials from all parts of the United States will attend the sessions. Col. R. Keith Compton of Richmond, Va., will be installed as the new president.

Very Artistic Appearance

W. J. Garrison, Manager of the Silicon Products Company, Ridgeway, Pennsylvania, writes: "We thank you for your Pit and Quarry Hand Book for 1928 and certainly want to compliment you on its arrangement and its very artistic appearance."

PIT AND QUARRY FOREIGN DIGEST

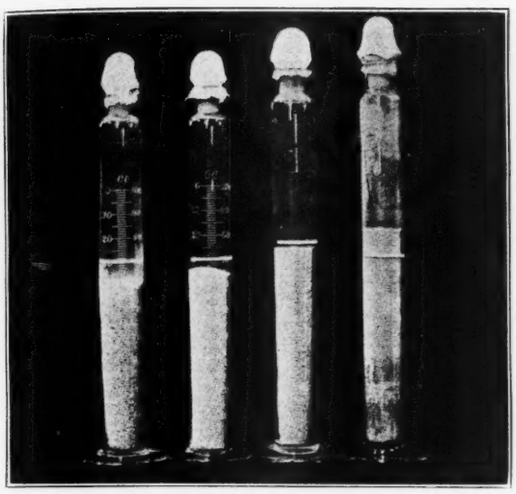


Figure 1—Shows That Fine Grinding Will Produce Greater bulking

Bulking of Grits and Fine Powders

The tests on cement illustrated in Fig. 1, show that finer grinding will produce greater bulking. Two cement samples from the same clinker, one ground to 10 per cent residue on the 180 mesh sieve and the other to 3 per cent residue were tested. The fine cement will be found about 17.5 per cent stronger than the coarser when tested in concrete and using the same weight of cement. But if the cement be measured by volume, the finer cement will weigh 9 per cent less than the coarser. Still the net gain in strength will be over 7 per cent while cement to the amount of 9 per cent will have been saved. If cement saving a residue of 10 per cent (180 mesh) is considered to weigh 90 pounds per cubic foot, then for every 1 per cent reduction in residue, the weight per cubic foot will fall 1.3 per cent. On the other hand, for equal weights of cement made into concrete, 1 per cent reduction in residue will increase the strength of the concrete by the following amounts:

Age	7 dys.	28 dys.	3 mos.	1yr.
Per cent Increase in Strength	2½	2	1¾	1½

The improvement in strength greatly surpasses the decrease in cement content by bulking, so that a stronger concrete will result from the use of a finely ground cement, even when it is bulked during measuring. Other experimental results indicate that for concrete proportioned by volume, finely ground cement, in spite of its bulking, will produce concrete fully as watertight as that with coarse cement. Moist sand bulks greater than dry sand, but if excess water is present so that the sand is completely inundated the volume becomes practically that of the dry sand. By J. E. Worsdale (The Structural Engineer, London, April, 1928).

Porous Gypsum Plaster

Gypsum which is partly dehydrated, but not to the same degree as plaster of Paris is mixed with a gas-generating agent such as calcium carbonate and with water containing an acid such as hydrochloric. G. O. Case (British Patent 266, 524).

The Sand Inundator

The Bertin sand inundator consists of a container subdivided into two sections, the upper one A (Fig. 2) being used to measure the sand, and the lower section D to measure the water. Both sections are adjustable. The adjustment is made so that the amount of water will be just that which the sand will hold, which is practically equal to the voids in the sand plus the water in D. The bottom, C, of section A is provided with screened openings as shown in section AA, which permit water to enter into and exit from section D, but exclude sand from entering it. In operating, section D and about one-third of A are filled with water and then A is filled with sand. The container is then emptied into the mixer hopper delivering to the mixer definite quantities of sand and water for each batch. J. E. Worsdale (The Structural Engineer, April, 1928).

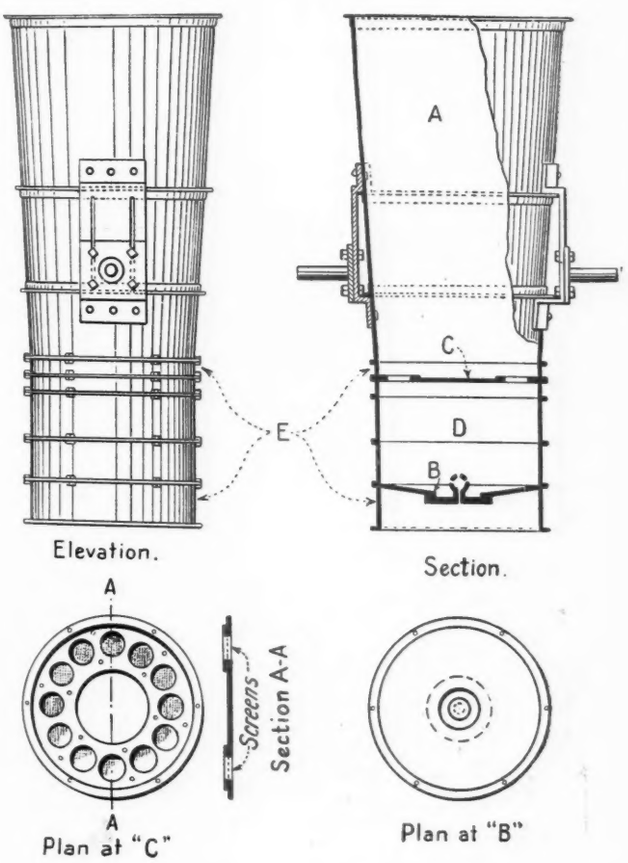


Figure 2—Shows the Sand Indulator

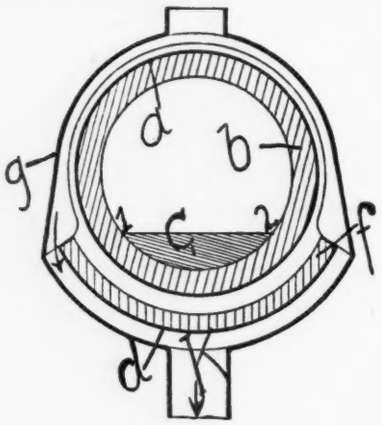


Fig. 3.

A New Rotary Kiln

Around the under side of the kiln a (Fig. 3), which contains the lining b, there is a heat insulating layer formed by the plate d and the nonconductor f. The heat protecting screen d is bound together with the jacket g from which the air is sucked out by a pump through k. By this means, the heated air is removed in the direction of the arrow, so that between the insulating screen d and the kiln the layer of air is at rest. In this manner, that portion of the kiln upon which the material to be burned lies, that is, the region from 1 to 2, is protected to the greatest possible extent from loss of heat. G. Polysius Eisengiesserei und Maschinenfabrik (German Patent 454,195).

Blast Furnace Slag in Cement

Hydraulic slag sand is colored brown to black, in characteristic fashion, by the use of an acetic acid solution of lead acetate. This becomes very clear under the microscope as is shown in Figures 4 and 5. Granules of clinker from about 15 cements never give the same effect. This method, therefore, will serve to detect additions of blast furnace slag to cements. H. W. Gonell (Zement, March 15, 1928).

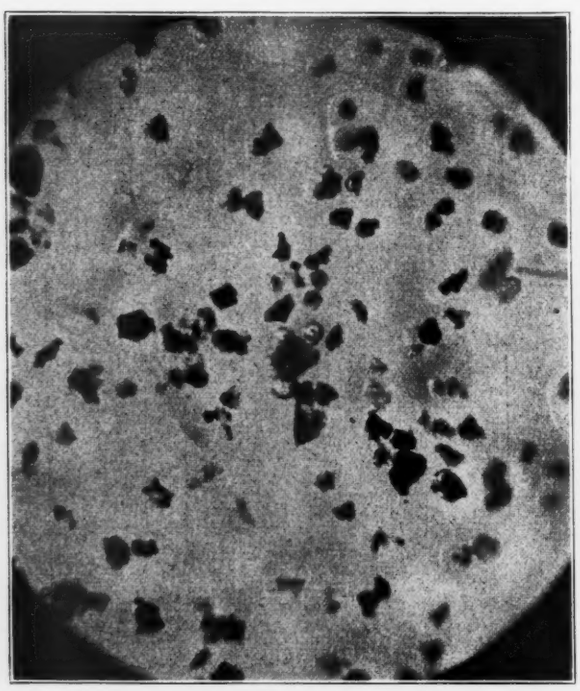


Fig. 4

Weathering of Concrete

It is accepted today by most workers that the hydration products of Portland and other similar cements are in the form of gels. The amount of water associated with these gels adjusts itself to equilibrium with surrounding moisture. This balance is also affected by the presence of unhydrated particles of cement clinker, which may react with water long after the mass has set. The weathering of cement and concrete depends largely on these two factors. Set neat cement is practically impervious to water, yet due to shrinkage when setting a less pervious mortar is obtained with a cement-sand mixture. Tests show that concretes made with rapid-hardening Portland and aluminous cements are much more impermeable than those made with ordinary cements. Either the rapid hardening cements can better resist the stresses induced during the period of shrinkage because of the much greater rate at which both the cohesive and adhesive strengths are developed, or the cement substance is better able to yield and flow, thus releasing the strains. Perhaps both explanations play a part. The microscopic cracks produced by shrinkage on setting are important because they are the primary cause of any lack of weather resistance that concrete products may show. If the water cannot get in, then soluble salts cannot be washed out nor can the embedded steel rust. When water does get in and washes out salts which can crystallize in the cracks, forces are introduced which cause the cracks to widen, often exposing unhydrated particles of clinker which then hydrate causing further straining.

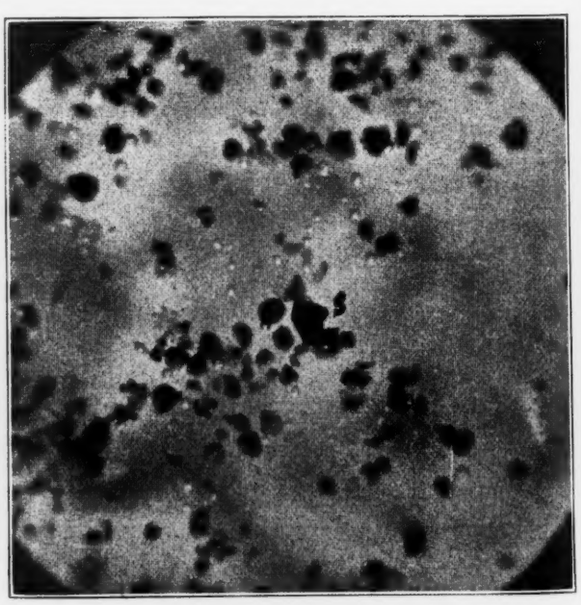


Fig. 5

INTIMATE NEWS OF MEN AND PLANTS

Colton Plant Expands

The proposed expansion program of the California Portland Company at Colton has been enlarged to a half million dolars, according to announcement. Two items in the program are the installation of two large kilns and the erection of eight raw mix silos. The kilns are 10 by 204 feet and supported on steel and concrete foundations. The silos are to be 32 feet in circumference and stand 65 feet.

Old Colony Company Changes Quarry Haulage

The Old Colony Crushed Stone Company of Quincy, Massachusetts, have changed their scheme of quarry haulage. They are now using a Mack truck tractor equipped with a side dump body and a trailer equipped with the same kind of a body. These bodies were built by the Easton Car and Construction Company of Easton, Pennsylvania, and have a capacity of about 7½ tons.

The accompanying illustration shows the unit loaded with stone for haulage. The outfit is to be used for quarry haulage from the steam shovel to the primary crusher. The load of stone is dumped directly into a 48 by 60 inch Allis Chalmers McCully jaw crusher. The product from this jaw crusher is conveyed to two 16 inch, gyratory crushers from which the tailings are recrushed in 10 and 6 inch fine reduction Allis Chalmers McCully crushers.

Salem Opening Quarry

The town manager of Salem, Virginia has a large crew of men stripping a section of a limestone deposit to open a quarry near the town. The stone will be used primarily for paving the streets, but as conditions warrant and the plant becomes equipped, much of it will be used for construction purposes.

New Jersey Sand and Gravel Opens Branch

The New Jersey Sand and Gravel Company, of Spring Lake, New Jersey, has acquired the Thompson trestle and equipment for unloading sand and gravel at Red Bank. The company is largely owned by Red Bank and Monmouth County citizens who are interested in the branch being opened there. The company operates in Wayside, Farmingdale and Spring Lake.

Fire Damages California Plant

Fire, starting at about five o'clock in the morning of March 24th, swept through the crushed stone plant of the Blue Diamond Material Company, near Corona, California. According to information from the main office of the Company in Los Angeles, the damage is estimated at nearly $160,000 which is wholly or nearly covered by insurance.

The plant at Corona is one of the largest operated by the Blue Diamond and will probably be rebuilt in a short time. It is stated that an improvement program at the plant is underway and a shipment of $125,000 worth of equipment is en route to Corona for the purpose of completely modernizing and expanding the operations.

New Phosphate Plant for Florida

The Southern Phosphate Corporation of Lakeland, Florida, has recently acquired 2,500 acres of phosphate bearing land, near Export. It is announced that plans are under way for an extensive development of the property at an early date.

Lime Companies Merge

It is announced that the Charles Warner Lime Company of Wilmington, Delaware and the Merion Lime and Stone Company of Swedeland, Pennsylvania, have completed a merger. The entire assets and properties of both companies have combined to reduce overhead and be in close contact with a greater number of their customers.

New Plant for Ohio

Work has been started on a new $50,000 sand and gravel dredging and storage plant by the Moundsville Sand Company just north of Moundsville, Ohio. It was designed by the C. C. Smith Sons and the equipment is being furnished by the Link Belt Company and Street Brothers Machine Works.

Hauling Stone in Old Colony Plant

DISTRIBUTION OF CEMENT

The following figures show shipments from Portland cement mills distributed among the States to which cement was shipped during January and February, 1927 and 1928.

Portland cement shipped from mills into States in January and February, 1927 and 1928, in barrels*

Shipped to	January		February	
	1927	1928	1927	1928
Alabama	132,569	235,233	127,020	254,968
Alaska	0	396	132	928
Arizona	54,088	82,184	41,677	72,365
Arkansas	46,014	62,143	59,309	76,288
California	998,230	1,030,965	649,302	909,617
Colorado	28,050	32,389	45,006	33,593
Connecticut	34,587	74,600	58,534	52,401
Delaware	11,170	13,077	13,885	11,304
District of Columbia	50,552	30,341	59,964	55,069
Florida	283,031	108,750	285,604	105,590
Georgia	119,770	113,857	134,787	97,616
Hawaii	22,491	20,290	31,022	26,923
Idaho	15,085	6,408	27,495	11,020
Illinois	301,829	354,763	417,054	401,092
Indiana	74,589	88,411	143,650	102,747
Iowa	38,157	30,488	55,837	41,520
Kansas	68,122	78,460	107,823	107,291
Kentucky	42,851	54,991	78,183	52,748
Louisiana	116,633	94,929	122,629	97,484
Maine	6,295	12,487	5,422	10,738
Maryland	135,015	87,650	123,421	66,413
Massachusetts	70,354	104,382	81,457	100,548
Michigan	258,848	267,206	301,666	287,114
Minnesota	41,396	50,480	61,047	49,334
Mississippi	51,325	57,528	62,783	50,677
Missouri	113,581	146,411	173,365	170,275
Montana	7,261	8,289	9,845	10,578
Nebraska	22,675	26,815	39,594	33,967
Nevada	2,724	3,293	3,649	4,524
New Hampshire	16,172	17,647	9,599	18,066
New Jersey	227,489	318,204	279,739	296,641
New Mexico	12,503	12,861	20,957	21,302
New York	700,414	800,428	855,484	768,681
North Carolina	141,582	135,292	168,720	109,830
North Dakota	3,575	2,102	3,081	2,641
Ohio	226,786	265,048	321,218	298,885
Oklahoma	164,266	201,422	191,130	203,245
Oregon	35,715	37,133	53,310	74,793
Pennsylvania	365,107	441,419	476,001	404,956
Porto Rico	2,550	0	1,275	0
Rhode Island	19,352	25,325	19,874	18,701
South Carolina	42,537	102,178	47,821	75,677
South Dakota	5,094	5,988	10,170	10,434
Tennessee	86,485	88,966	102,871	109,112
Texas	362,004	405,245	371,525	383,884
Utah	13,356	9,575	15,527	15,131
Vermont	5,606	11,363	4,472	15,902
Virginia	62,199	91,941	92,723	104,674
Washington	104,608	90,604	124,266	128,568
West Virginia	47,871	39,992	64,296	44,944
Wisconsin	76,148	74,881	100,245	91,829
Wyoming	5,972	5,262	7,754	8,427
Unspecified	19,886	*37,918	18,914	22,737
	5,894,569	†6,498,010	6,682,134	6,514,792
Foreign Countries	73,431	47,990	48,866	48,208
Total shipped from cement plants	5,968,000	†6,546,000	6,731,000	†6,563,000

*Includes estimated distribution of shipments from three plants in January and February, 1927 and 1928.
†Revised.

Relation of Production to Capacity

	March		February	January	December
	1928	1927	1928	1928	1927
	Per cent	Per cent	Per cent	Per cent	Per cent
The month	51.7	61.9	47.5	49.4	60.7
The 12 months ended	74.6	76.0	75.1	74.5	76.2

Production, shipments, and stocks of finished Portland cement, by districts, in March, 1927 and 1928, and stocks in February, 1928, in barrels

	Production		Shipments		Stocks at end of month		Stocks at end of February
	1927	1928	1927	1928	1927	1928	1928*
Eastern Pa., N. J. and Md.	2,997,000	2,512,000	3,081,000	2,396,000	5,677,000	6,682,000	6,566,000
New York	597,000	587,000	481,000	499,000	1,568,000	1,865,000	1,778,000
Ohio, Western Pa., & W. Va.	1,262,000	851,000	932,000	833,000	3,272,000	3,411,000	3,393,000
Michigan	551,000	560,000	596,000	505,000	1,975,000	2,260,000	2,205,000
Wis., Ill., Ind., & Ky.	1,308,000	933,000	1,198,000	1,004,000	3,348,000	3,661,000	3,732,000
Va., Tenn., Ala., Ga., Fla. & La.	1,201,000	1,268,000	1,220,000	1,298,000	1,178,000	1,935,000	1,966,000
Eastern Mo., Ia., Minn. & S. D.	714,000	687,000	729,000	730,000	3,226,000	3,912,000	3,955,000
Western Mo., Neb., Kan. & Okla.	753,000	645,000	725,000	829,000	1,584,000	1,463,000	1,647,000
Texas	465,000	552,000	492,000	563,000	448,000	449,000	460,000
Col., Mont., Utah	118,000	160,000	138,000	174,000	470,000	482,000	496,000
California	1,179,000	1,171,000	1,195,000	1,082,000	692,000	853,000	764,000
Ore. & Wash.	305,000	297,000	313,000	222,000	484,000	463,000	387,000
	11,450,000	10,223,000	11,100,000	10,135,000	23,922,000	27,436,000	27,349,000

CEMENT STATISTICS FOR MARCH

The Portland cement industry in March, 1928, produced 10,223,000 barrels, shipped 10,135,000 barrels from the mills, and had in stock at the end of the month 27,436,000 barrels, according to the United States Bureau of Mines, Department of Commerce. The production of Portland cement in March, 1928, showed a decrease of 10.7 per cent and shipments a decrease of 8.7 per cent, as compared with March, 1927. Portland cement stocks at the mills were 14.7 per cent higher than a year ago.

The statistics here presented are compiled from reports for March from all manufacturing plants except two, for which estimates have been included in lieu of actual returns.

In the statement of relation of production to capacity the total output of finished cement is compared with the estimated capacity of 155 plants at the close of March, 1928, and of 141 plants at the close of March, 1927.

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20c each. State number of patent and name of inventor when ordering.

1,662,824. Mining-machine. Morris P. Holmes, Claremont, N. H, assignor to Sullivan Machinery Co.

1,662,825. Mining-machine. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,826. Controlling mechanism. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,893. Connector for mine-cars and the like. John F. O'Connor, Chicago, Ill., assignor to W. H. Miner, Inc.

1,662,902. Shovel-crane boom. Leslie A. Russell, Milwaukee, Wis., assignor to Koehring Co., same place.

1,663,292. Shovel-operating mechanism. Seth Carlson, Chicago, Ill., assignor to Weller Mfg. Co., same place.

1,663,355. Conical crushing-mill. Charles F. Smith, Arthur C. Thiele, and Lloyd P. Walker, Milwaukee, Wis., assignors to Smith Engineering Works, same place.

1,663,574. Apparatus for handling bulk materials. William M. Venable, Pittsburgh, Pa., assignor to Blaw-Knox Co.

1,663,881. Centrifugal grinding mill. William A. Gibson and James G. Burke, Allentown, Pa., assignors to Dradley Pulverizer Co., same place.

1,663,917. Shoveling-machine. Edmund C. Morgan, New York, N. Y.

1,664,128. Mining and loading machine. Edmund C. Morgan, New York, N. Y.

New Incorporations

California Talc Co., office, 650 S. Spring St., Los Angeles, Calif.; plant, 837 Jackson St., Los Angeles, Calif. $150,000. R. W. Glendinning, Pres.; Sterling C. Lines, V. P.; G. A. Lansdell, Treas.; Harry F. Hossack, Sec.

Standard Sand & Gravel Co., Inc., 427 Merchants Bank Bldg., Fort Smith, Ark. $9,000. J. W. Wood, W. B. Pattison, W. E. Harrell.

Oil City Sand & Gravel Co., Oil City, Pa. $100,000. Allegheny River Sand & Gravel Co., West Hickory, Pa., being reorganized and plant to be moved to Oil City, operating as Oil City Sand & Gravel Co. Capt. Charles A. Smith, Blawnox, Pa., Mgr.

Montana Gypsum Products Co., Anaconda, Mont. $250,000. Dr. L. C. Ford, Lima; E. C. Davis, George W. Craven, Garfield B. Perier, and Alex Walker, of Butte. To mine and process gypsum and its products, at Lima, Mont.

Anderson Stone Co., 701 Oakland Place, Fort Smith, Ark. H. C. Bass.

Patapsco Power, Light & Mineral Co., Main St., Sykesville, Md. $100,000. W. H. D. Warfield, Pres. To prepare feldspar, limestone, and flint for commercial purposes, at Marriottsville, Md.

Pacific Rock Co., Oakland, Calif. $40,000.

Charles River Sand & Gravel Co., Newton, Mass. Salvatore Messina, Pres. 250 shares n.p.v.

California Onyx Co., Los Angeles, Calif. $100,000. H. W. Elliott, George D. Mitchell, E. J. Louis, F. W. Brand, H. Eisele.

Kokomo Stone Co., Kokomo, Ind. 376 shares n.p.v. To quarry stone.

Shaw Stone & Ballast Co., 11501 Longwood Drive, Chicago, Ill. $20,000. E. C. Shaw, R. P. Oehm, Wm. J. McDonald. Negotiating for purchase of land for plant in Kansas.

Gulf Gravel Co., Post-Dispatch Bldg., Houston, Tex. W. L. Pearson. $40,000.

Alabama Mica Co., Inc., 985 Conroy Road, Birmingham, Ala. R. T. Clayton. $50,000.

Missouri Granite & Construction Co., 7607 Warwick Drive, St. Louis, Mo. Joseph Schroeder, Francis R. Lowther.

Wisconsin Silica Co., Westfield, Wis. 250 shares, $100 each. J. O. Mortenson, J. A. Conant, B. R. Crockett. To crush stone into silica.

EXPORTS AND IMPORTS

Compiled from the records of the Bureau of Foreign and Domestic Commerce. Figures for 1928 subject to revision

Exports of hydraulic cement by countries in February, 1928

Exported to	Barrels	Value
Canada	913	$ 6,094
Central America	23,082	70,565
Cuba	5,172	14,832
Other West Indies	2,581	6,861
Mexico	4,899	15,874
South America	22,319	84,149
Other countries	3,862	23,245
	62,828	$221,620

Imports of hydraulic cement by countries, and by districts, in February, 1928

Imported from	District into which imported	Barrels	Value
Belgium	Florida	19,206	$ 23,854
	Galveston	6,000	7,948
	Los Angeles	5,000	6,005
	Massachusetts	24,107	41,008
	Oregon	4,120	5,163
	San Antonio	9,000	11,578
	South Carolina	27,905	34,334
	Washington	3,000	4,011
	Total	98,338	$133,901
Canada	Vermont	465	685
Denmark	Porto Rico	48,722	59,767
France	New York	2,216	6,673
Germany	Philadelphia	6	39
Poland and Danzig	Maryland	4,166	3,555
United Kingdom	New York	10,495	12,905
	Grand Total	164,408	$217,525

Exports and imports of hydraulic cement, by months, in 1927 and 1928

Month	Exports				Imports			
	1927		1928		1927		1928	
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value
January	75,346	$ 254,672	56,400	$204,875	193,175	$ 269,661	234,753	$342,797
February	71,404	233,985	.....	.....	130,421	200,680	.....	.....
March	67,956	240,165	62,828	221,620	181,145	261,519	164,408	217,525
April	72,383	243,832	.....	.....	191,868	313,262	.....	.....
May	59,332	205,574	.....	.....	178,929	263,618	.....	.....
June	69,205	237,281	.....	.....	129,111	201,682	.....	.....
July	72,337	229,737	.....	.....	175,035	249,665	.....	.....
August	61,371	209,198	.....	.....	117,605	170,167	.....	.....
September	57,888	207,817	.....	.....	233,066	297,716	.....	.....
October	67,639	230,668	.....	.....	221,274	321,777	.....	.....
November	79,869	257,476	.....	.....	141,485	190,419	.....	.....
December	62,099	226,960	.....	.....	156,609	209,205	.....	.....
	816,829	$2,776,765	.....	.....	2,049,723	$2,949,371	.....	.....

Domestic hydraulic cement shipped to Alaska, Hawaii, and Porto Rico, in February, 1928

	Barrels	Value
Alaska	1,789	$ 5,395
Hawaii	20,375	48,342
Porto Rico	2,886	7,359
	25,050	$61,096

Production and stocks of clinker (unground cement), by districts, in March, 1927 and 1928, in thousands of barrels

District	Production		Stocks at end of month	
	1927	1928	1927	1928
Eastern Pa., N. J. & Md.	2,394	2,939	2,129	1,948
New York	635	750	579	1,023
Ohio, Western Pa., & W. Va.	1,194	1,123	1,608	1,890
Michigan	901	908	1,765	1,880
Wis., Ill., Ind., & Ky.	1,448	1,662	1,781	2,457
Va., Tenn., Ala., Ga., Fla., & La.	1,211	1,226	816	995
Eastern Mo., Ia., Minn., & S. Dak.	796	913	931	1,096
Western Mo., Nebr., Kans. & Okla.	704	667	676	559
Texas	451	544	125	149
Colo., Mont. & Utah	171	212	863	437
California	1,143	1,180	1,143	1,419
Ore. & Wash.	349	377	581	614
	12,397	12,501	12,997	14,467

Production and stocks of clinker, by months, in 1927 and 1928, in thousands of barrels

Month	Production		Stock end of month		Month	Production		Stock end of month	
	1927	1928	1927	1928		1927	1928	1927	1928
Jan.	10,410	11,858	9,989	*9,672	July	15,697	.....	9,609	.....
Feb.	9,253	11,363	11,943	*12,237	Aug.	16,396	.....	7,887	.....
Mar	12,397	12,501	12,997	14,467	Sept.	15,931	.....	6,490	.....
Apr.	14,246	.....	13,335	.....	Oct.	16,469	.....	5,960	.....
May	15,677	.....	12,514	.....	Nov.	14,698	.....	6,374	.....
June	15,437	.....	10,926	.....	Dec.	13,177	.....	*7,675	.....

*Revised.

G. M. & N. Sponsors Geological Tour

The Gulf, Mobile and Northern Railroad recently sponsored a tour of members of the American Mining Congress which was conducted by Dr. Henry Mace Payne, geologist for the company. The party included Dr. Frank L. Hess, chief engineer, director of rare metals and non-metallics, Bureau of Mines, Washington; Dr. Walter F. Pond, state geologist of Tennessee, Nashville; R. E. Niebling, manager, Certainteed Products Corporation, New Orleans; James L. Akers, vice president and general manager of the Annette Mines Company, Coker Creek, Tenn.; and L. J. Folse, manager of the Mississippi State Board of Development. G. M. White, general passenger agent and Tom Martin represented, with Dr. Payne, the railroad company.

The group went to Mobile, Alabama, following the meeting of the Southern Division of the American Mining Congress and spent some time in Jones, Jasper and Smith Counties, inspecting deposits of ochre, gypsum, copperas, building stone, copper pyrites, and traces of what are expected to analyze as antimony. At Louisville, the party was welcomed by R. G. Brown, retiring chairman of the Southern Division of the Mining Congress. They proceeded into the country for a view of the deposits of baukite, fuller's earth, glass sand, slip clay, coal and kaolin. Considerable time was spent in visiting the deposits of bentonite, terra cotta clay, novaculite and paint pigments in Tippah, Benton and Union Counties, Kentucky. An informal dinner was given by the Louisville Rotary Club in honor of the guests of the G. M. and N.

New Stone Plant for Indiana

The Chamber of Commerce of Bedford, Indiana, has announced that the Edward Edinger Company is planning to develop a stone deposit at that point. The quarry and crushing operations will be located on the Chicago, Milwaukee and St. Paul Railway near the plant of the Indiana Limestone Company.

Hoadley Will Add Another Plant

The B. G. Hoadley Quarries Company of Bloomington, Indiana, has purchased a large acreage of stone land on Stoutes Creek, three miles northwest of Bloomington, where a quarry will be developed and a crushing plant erected. It is announced that the new plant will be operating in about three months.

Another Cement Merger

The General Cement Corporation has organized to consolidate the Pennsylvania-Dixie Cement Corporation of Nazareth, Pennsylvania, and the North American Cement Corporation of Albany, New York. Stock holders and holders of the 6½ per cent sinking fund debentures series A of the North American Cement Corporation have been called to a meeting on May 1, in the National City Bank to pass on the merger. Stock holders of the Pennsylvania-Dixie will hold a special meeting on May 2 to consider the consolidation.

If the merger is approved by the majority of stock holders, Frederick J. Kelly, president of the North American, will be president of the new company, while John A. Miller, president of the Penn-Dixie firm, will become chairman of the board of directors. The combined properties will have a productive capacity of 14,000,000 barrels of cement per year. The geographical distribution of the plants will afford access to all the important markets on the Atlantic seaboard on a favorable freight and shipping charge.

Granite Quarry Installs New Machinery

Several motors and saws are being installed at the plant of McGilvary and Raymond, southwest of Foster, California, at a cost of between $20,000 and $30,000. The quarry has been in operation for several years and is said to be one of the more important industries of San Diego County. Prior to this time there had been no machinery for sawing or shaping the blocks. With the new equipment, the waste material may be retained as refuse and the finished product shipped.

Bellevue Company Purchases Sand and Gravel Deposit

The Bellevue Sand and Gravel Company, headed by Capt. George Schneider of Clinton, has purchased the John Haverland farm, located two miles north of Bellevue, Iowa. The new tract is near the river and has ample railroad facilities. The production which is about 16 cars per day will be greatly increased with the addition of new equipment.

Dolese Brothers Move

General offices of the Dolese Brothers Company have been moved to 205 West Wacker Drive, Chicago, Illinois. The company occupies suite 1022 to 1026 and may be reached by telephone, State 1400.

New Sand and Gravel Pit for Illinois

A new company consisting of M. Ebert and Sons, Clyde Smith, A. D. and F. L. Humenshine and Joseph Naffinger has been formed to develop sand and gravel deposits near Washington, Illinois. The plant will be operated on the drag scraper system and will be equipped with the more modern crushing, washing and screening machinery.

Erect Large Feldspar Mill

According to reports, the largest feldspar grinding mill in the United States is being erected near Burnsville, Yancy County, North Carolina. The mill will produce 150 tons of finished product per day.

The Feldspar Milling Company which was organized with an authorized capital of $500,000 to develop the property is headed by J. F. Shinn, secretary and general manager of the Norwood Company; C. S. Smart, manager of the Locke Cotton Mills of Concord, was elected vice president; and Senator James J. Hyatt was chosen secretary and treasurer.

Penn-Dixie Will Improve New Iowa Plant

The plant of the Pyramid Portland Cement Company west of Des Moines, Iowa, was recently purchased at a foreclosure sale by the Penn-Dixie Cement Corporation for a consideration said to be $1,050,000 cash. Officials of the purchasing company have announced that it was decided to double the capacity of the plant and that an improvement and enlargement campaign with the installation of the necessary new equipment is underway.

Ottawa Silica Company Buys United States Silica Plant

All of the property of the United States Silica Company, including the 65 acres of land and equipment has been purchased by the Ottawa Silica Company, according to announcement It is planned to continue the operation of all three mills and manufacture and distribute the well known brands of sand.

Asphalt Plant Burns

Fire starting from a defective tank completely destroyed the asphalt plant of the city of Topeka, Kansas, on April 7. The fire, which destroyed all but the asphalt mixer, is supposed to have originated from a fire that the night watchman started beneath one of the tanks in which the paving material is melted.

NEWS OF EQUIPMENT MANUFACTURERS

A Flexible Bolt

Through the development of the preformed type of wire rope which makes possible the attachment of fittings by the processing method that compels the fitting to become an integral part of the rope, the American Cable Company has recently perfected the Tru-Lay—Tru-Loc flexible bolt.

These new bolts may be used in countless places in and around the plant or mill or in any place where rigid U bolts are impracticable. They are finding ready acceptance as auxiliary hangers for power shafts, suspension brackets for overhead steam or water piping, shackle bolts for temporary wall boxes, tanks, etc., for scaffolding and tackle, on various parts of machinery, and in other places where semi-flexible connections are necessary.

The principle on which the new flexible bolt rests is the preformed type of wire rope. Preforming the wires and strands to the exact helical shape they must assume in the completed rope results in a cable that does not require seizing but may be cut like a rod. This type of rope permits a close fitting attachment to be slipped over the unseized end of the rope and to be processed so that the steel of the fitting cold flows into the interstices of the rope and thus becomes practically an integral part thereof. Naturally such fittings can be threaded for a nut or capped for a head. The flexible bolt which has resulted from these developments is available in varying lengths.

Air Preheater Data

The Combustion Engineering Corporation is distributing its catalog AH-3 which illustrates and discusses preheaters through the entire 23 pages. The introduction deals with the advantages of preheating and refers to a former theory that both the preheaters and economizers could not be justified. The present day trend toward high capacities and high steam pressures has made it apparent that in many cases, both types of equipment are justified by the increased efficiency effected. Since high efficiencies necessitate low stack temperatures, it is frequently economical to use both economizers and preheaters.

There are several types of preheaters in use at the present time, which may be grouped into two classifications—those employing either the recuperative or the regenerative principle. The preheaters manufactured by the Combustion Engineering Corporation are of the recuperative, which is said to be justified by the advantages obtained by that type. The preference accorded to the recuperative type is because of such advantages as its ability to transfer a maximum amount of heat from gas to air and to render continuous service without maintenance.

Convertible Speedcranes

The Moore Speedcrane Company is distributing a 28 page illustrated catalog which gives the desired data on the cranes manufactured by the Manitowoc Shipbuilding Corporation and marketed by Moore. The speedcrane is readily convertible into a shovel, trenchhoe or dragline, according to the catalog, which contains a number of photographs, line drawings and letters confirming the claims for the crane. Among the claims made for this machine are, exceptional speed with an accelerator for increasing speeds, ease of operation, only one reversing clutch, freedom from delays for repairs, simplicity of construction, accessibility of parts, a better oiling system and made of the better grade of materials.

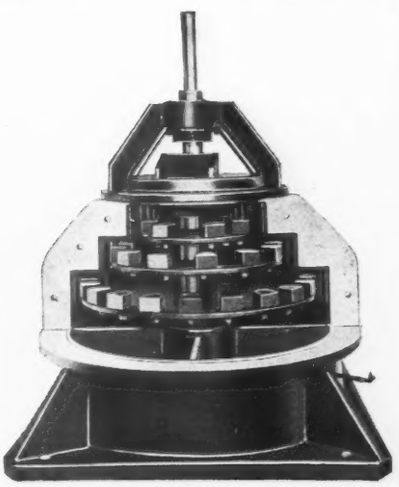
McCormick With Leeds

William McCormick, sales manager for the Niles Tool Works and Pratt and Whitney in the Pittsburgh district, has resigned. He has been appointed western sales representative for Leeds, Tozzer and Company, Inc.

A New Pulverizer

The Centripact Pulverizer Corporation is distributing a four page bulletin which illustrates and describes the new Centripact, ideal, attrition pulverizers as being safe, simple and economical. They were designed, by a mining engineer, to be a most satisfactory method of ore reduction and to be of large capacities, with a low maintenance cost and a low power consumption. This pulverizer is said to combine impact with attrition, eliminating all grinding or rubbing.

There are three or more horizontal discs of increasing diameters, equally spaced upon a vertical chrome nickel steel shaft, mounted in ball bearings. A chilled manganese steel hammer is bolted on each disc. Perfect balance is secured through equal spacing. A centrifugal force drives the material outward to the hammers as it feeds to the center of the top disc. The hammer blow causes the material to impact upon the corrugated chilled manganese steel breaker ring from which the large pieces rebound and are struck by a following hammer. The finer particles are then drawn downward to the space behind the second disc hammers where centrifugal force again places them in line for a greater hammer, because of the greater disc diameter to the breaker ring. By the same procedure, it is taken to the third and last set of hammers and breaker ring. As the particles decrease in size, they are



The Centripact Pulverized

struck ever increasing blows while they pass from stage to stage. In the forward driving and rebounding of the pieces between the hammers and breaker rings, they collide with each other and each particle assists to reduce the size of the other, which is attrition. The first set of hammers acts as the initial breaker, and the succeeding stages accomplish the pulverizing, while the finished material is blown at high velocity from the third stage due to the fan effect of the rotor.

The shell and housing are of semi-steel; rotors are of steel; hammers and breaker rings are of chilled alloy manganese steel or a special mixture of white iron where materials are especially abrasive; and it is driven by a chrome nickel steel shaft. The outstanding construction features are only one moving part, two heavy duty ball bearings, perfect rotating balance and parts are easily interchangeable. The maximum sizes to be pulverized are 1½ inch which may be reduced to from 20 to 350 mesh as required.

New Wood Dump Bodies

The Wood Hydraulic Hoist and Body Company has recently begun the manufacture of its new J-1 all purpose dump body. It has been designed to meet the growing demand for a light, well built body for use on the pneumatic tired speed chassis of shorter wheel base. It is constructed of 10 gauge sheet steel with square corners and front and rear extended for use with sideboards. The double acting tailgate has the control housed underneath the running board which gives protection from injury and leaves the sides of the body free. With the sides in place and the tailgate hinged, it may be used as a dump body for handling sand, gravel and similar bulky material. It may be converted into a platform body, by removing the sides and opening the tailgate, level with the floor of the body.

New All Purpose Dump Body

The Wood Pacific Coast factory has designed and is building the sturdy "Boulder Body." Extra strength has been built into the parts of the body that must bear the brunt of impacts when huge boulders are dropped from a steam shovel. A number of cross members have been added and the slanting sides are reinforced and will stand the most severe shocks and strains. Boulder bodies weigh from 4000 to 5000 pounds exclusive of the hoist.

New A. C. Manual Starter

A new manual across the line A. C. motor starter (CH-9115) is announced by The Cutler Hammer Manufacturing Company, of Milwaukee, Wisconsin. Designed to meet the need for an inexpensive manual starter, it includes such outstanding advantages as overload cutouts giving complete motor protection; cadmium plated, double break, roller type contacts; and small size, safety, dust proof enclosing case.

The roller type contacts seem to be the forerunner of an unusual trend in motor control design. They are of the double break type, cadmium plated, and by breaking the arc in two places, give several times the life of ordinary contacts. In addition, the contact rollers turn after each operation to present a new contact surface for the next operation. Complete motor protection is obtained during both the starting and running periods. The thermal overload cutouts provide the necessary time interval to take care of starting inrushes without shutting down the motor.

The starter is quite small and compact; the enclosing case is dust-proof and the cover is in two parts. This permits opening the lower section only, for replacing fusible links in the thermal overload cutouts. The cover can be opened only when the starter is in the "off" position and all current carrying parts are "dead." Installation can be made without removing the panel from case. All parts are easily accessible for quick inspection.

Expansible Tooth Sprocket

A unique device for prolonging the life of sprocket chain as well as sustaining maximum efficiency of operation throughout its entire life, has been developed by The Union Chain and Manufacturing Company.

This is a specially designed expansible sprocket, the teeth of which may be adjusted from time to time to accommodate the natural wear and consequent elongation of the links of a chain. This elongation, though seemingly slight in any one link, is multiplied by the number of links in engagement with the sprocket, causing a misfit between chain and sprocket and a consequent jerky and noisy action; this shortens the life of both chain and sprockets, more or less power is wasted, and the trouble naturally increases with each day's added wear in the chain bearings.

The sprocket is constructed with adjustable teeth of special design. Both sides of the body rim are machined to insure true running and to receive the teeth which straddle and are firmly clamped to the rim. Turned bolts closely fitted in the rim project through elongated holes in the teeth, the latter being secured relatively to pitch diameter by means of square beveled-edge adjusting blocks fitted between lugs on the teeth; a hole is jig-drilled through the blocks at a point four varying distances from the edges, and when the blocks are mounted on the bolts the pitch diameter of the sprocket is governed by the arrangement of the blocks.

Hydraulic Diggers Discussed

The W. M. Blair Manufacturing Company is distributing an illustrated 16 page catalog entitled "The North Hydraulic Digger." It is described as a powerful rugged heavy duty unit designed for use on a Fordson tractor. This digger lifts its load by means of a hydraulic cyclinder which, in turn, receives its oil pressure from a rotary gear pump direct from the Fordson. The catalog illustrates the machine in actual operation excavating, grading, backfilling, bulldozing and snow loading.

Allen Bradley Issues Data

The Allen Bradley Company is distributing bulletins and price sheets for incorporation in the general catalogue which will bring it up to date. Bulletins 704, 709, 710, and 720 have been revised and will supersede bulletins of the same number in the catalogue. Superseding price sheets are numbered 640, also 704, 709, 710, 720 and 760. The new publications received are bulletins 209, 211 and 800, together with price sheets, 209 and 211.

L. L. McCants Joins Bates

L. L. McCants, who for a number of years has been identified with the cement industry in the South, recently became affiliated with the sales organization of the Bates Valve Bag Corporation of Chicago. The corporation has established a factory in Birmingham, Alabama, at which point Mr. McCants is manager of sales.

New Stock List

The Mid-Continent Equipment and Machinery Company is distributing stock list number 1148. It lists new and used equipment for contractors, sand and gravel plants, quarries, mines, material yards and industries.

A New Gasoline Shovel

The Conqueror, a new gasoline shovel of the full revolving type and fully convertible to dragline, back hoe, clamshell and crane service, has been placed on the market. The Conqueror is mounted upon a new and improved continuous tread truck frame of the double chain drive type.

The machine, as a shovel, carries a minimum length boom of 20 feet and a handle of 15 feet, with a back hitch type dipper, and for crane service carries a 45 foot boom of the structural lattice bow type, with built in tagline and with a fairlead for dragline service self-adjusting to any angle of the boom.

The new Conqueror is characterized by simplicity and sturdiness in construction, ease of maintenance and ready accessibility to its mechanical parts.

In changing the Conqueror from shovel to clamshell, back hoe or dragline service, no additions or changes are necesary in the operating machinery. The only changes required are those involved in changing the boom assemblies. This work may be done in the field in a few hours time.

This new shovel has been produced by The Osgood Company, Marion, Ohio, manufacturers of excavating machinery of long standing. An 80 h.p., 6 cylinder gasoline motor is mounted at the rear of the machine on the masive unit steel main body frame casting. Heavy unit steel side frames securely atached to the main body casting support the drum shaft and the reversing shaft. In this way, complete alignment of parts is constantly assured, and vibration is reduced to the minimum.

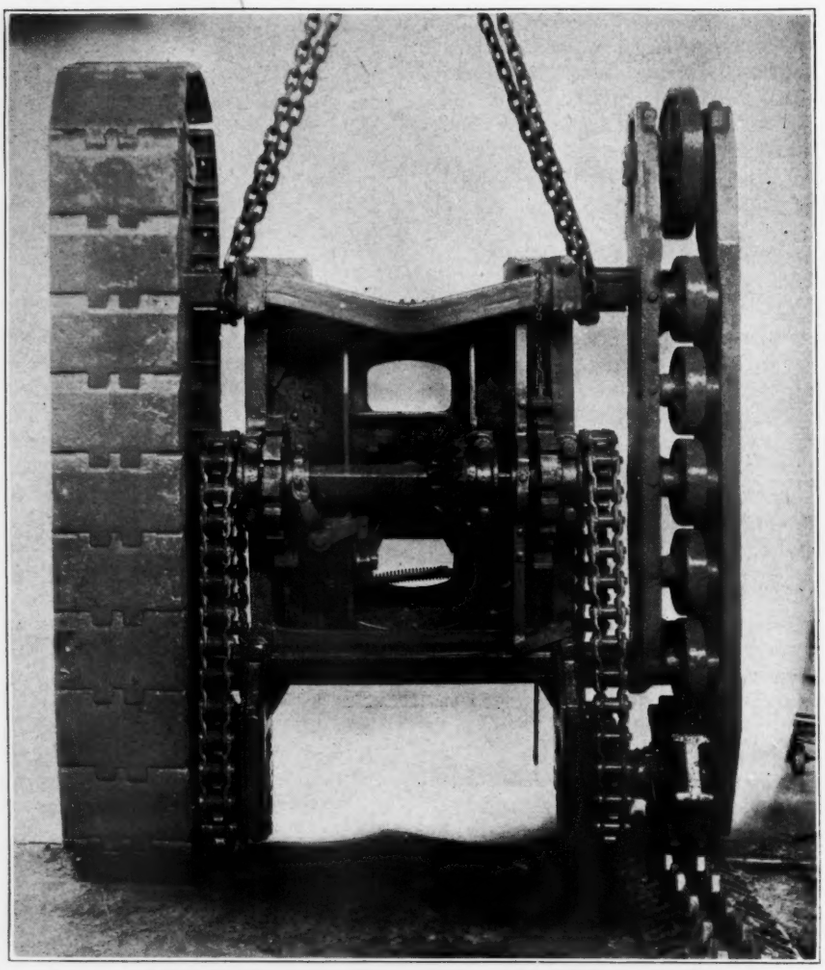
A special feature of this machine is the combination, cast iron gasoline tank and counterweight which is set into the deck at the rear of the motor. This arrangement saves space and extra counterweight and at the same time greatly reduces the fire hazard because of the thick heavy walls of the gas tank. The gas tank being located at deck level eliminates the necessity of gasoline pump or other accessories for filling the tank. The tank is large, having a capacity of approximately 75 gallons, which is usually enough for a two day supply.

The motor is equiped with a large 6-cell, 12 volt, 112 ampere hour storage battery, electric starter, voltage regulator, gasoline filter, Pomona air cleaner, and muffler, all of which tend to increase the efficiency of the Conqueror in operation. The voltage regulator is of a type similar to those used in governmental airplane service and automaticaly prevents the overcharging of the storage battery and maintains the charge at the proper point. The air cleaner used on the Conqueror is the best to be obtained upon the market today. It assures an ample supply of air to the carburetor free from dust and foreign particles which would impair the functioning of the motor.

The well known Osgood Servo Mechanism for setting the clutches on the hoisting and hold back drums, and the famous Osgood application of the wire rope crowd which has been used by Osgood for many years, are retained in the new Conqueror. The Servo Mechanism makes the motor do the work and relieves the operator of tiresome lever pulls. A touch of one finger is sufficient to make the control levers respond.

The Osgood application of the wire rope crowd is characterized by its extreme simplicity and high operating efficiency. It is self-adjusting to various boom angles. The essential parts, aside from the neessary wire ropes, consist only of the second or pull back drum on the main drum shaft and the shipper shaft drum. The hoisting rope is carried from the hoisting drum to the sheave at the boom point, thence to the dipper sheave block, and back again to a second boom point sheave and from there down to the shipper shaft drum where it is wrapped and anchored. A second and independent wire rope is carried from the pull back drum on the main drum shaft to the shipper drum where it, too is wrapped and anchored. The ropes are wound on the shipper shaft drum in such direction that the pull on the hoisting rope will turn the shipper shaft and crowd the handle out. This motion may be prevented by setting the brake on the pull back drum or may be reversed by throwing in the pull back drum clutch fric-

New Gasoline Shovel of the Full Revolving Type



The Truck Frame

tion. This type of crowd is very simple and easily controlled. It is automatic in action and has great crowding power, due to the multiplying action of the differential drum mounted on the shipper shaft. No slack ever occurs in the cables, consequently they need no attention.

The hoisting and crowding are perfectly timed and co-ordinated, making it easy to cut to any grade desired. The use of two drums make it unnecessary to add to the machinery when shovel is converted to clamshell or dragline.

The Conqueror is mounted upon a truck that is absolutely the last word and is the result of years of experience in designing truck frames. It is very heavy and rugged, exceedingly simple in construction, easy to control and maintain in operation. It has a travel speed of approximately seven-tenths miles per hour and will negotiate grade up to and in excess of thirty per cent. The Conqueror truck is designed to give the upper body a suitable mounting for travel over all kinds of material, ranging from rock to mud, and at the same time furnish sufficient locomotive power to enable it to move readily from one point to another.

The continuous tread truck is of the double chain drive type and is built up entirely of steel castings, with axles and cross travel shaft of hammered steel. The truck frame is a single massive steel casting. The roller path gear is of cast steel with cut teeth of the outside type, and is securely riveted into place on the truck frame casting, and has a machined shoulder to more securely hold it in place. The side frames are large unit castings and are of box section, bow type construction. Five travel rollers 14 inches in diameter are mounted within each side frame. These rollers operate on stationary shafts and are lubricated by recessed high pressure gun fittings.

An idler tumbler 25 inches in diameter is mounted in one end of each side frame casting, while in the opposite end the driving tumbler is mounted. Both tumblers are on stationary shafts with screw adjustments in tension. This arrangement makes it possible to adjust the tension of the tread belt from one end and the tension of the driving chain from the other end. The tread links are of improved type, one piece and overlapping, and of very strong, heavily ribbed construction. These links are pin connected by large steel pins in quadruple shear and are unlubricated. They are of the "full floating" type so that wear is distributed evenly about the pin, and making it easy to remove the pin when desired.

Power is transmitted from the vertical travel shaft to a single, one piece cross propelling shaft held in three heavy bearings. The cross travel shaft is of 4½ inches squared section and no keys are used in its construction. There is mounted on this shaft one bevel gear, two jaw type clutches and two bronzed bushed driving sprockets. Power is transmitted from the driving sprocket to driven sprocket on the driving tumbler by means of very heavy roller chains. There is one very heavy roller chain on each side delivering power direct to the tread belt driving tumbler.

The truck is steered by means of bell crank and levers controlled from the cab at the operator's position, irrespective of the position of the upper body or of the truck frame and without making connections of any sort. Automatic locking pawls hold the machine in any digging position and can be so controlled that movements will be prevented in one direction and be perfectly free in the opposite direction. Direction of moving for digging operations can be controlled as desired. The truck is bronze bushed throughout and is also lubricated by high pressure gun fittings that are so located that it is not necessary to get under for greasing. Every fitting is located in an accessible place.

The driving clutches can be easily disengaged for towing purposes. The Conqueror has ample deck space all around the machinery and the motor. The control levers are all banked to the left front side of the machine where the operator has a full view of his work at all times and has complete control of his machine without leaving his seat.

Motor controls, including oil pressure gauge, are banked on an instrument board within view and reach of the operator. The house or cab is all of steel construction, fully enclosed, and is provided with large door openings, and a window in the rear for light and ventilation. Electric dome and flood lights provide illumination from the storage battery for night operation. The machine is painted a rich olive green color.

American Hoist Moves Pittsburgh Office

On May first the Pittsburgh office of the American Hoist and Derrick Company will be moved from 1423 Farmers Bank Building to 604 Chamber of Commerce Building.

New Blast Hole Drill

The new four wheel crawler blast hole Loomis clipper drill has recently been developed and is described in an illustrated bulletin "4 CR44," being distributed by the Loomis Machine Company. This type has been developed especially for negotiating extra soft ground and doing work in the spring over soft surfaces when the frost is coming out of the ground. The tractor wheels were developed, the rear two for driving and the front as idlers, to distribute the weight over a large surface and prevent digging, when power is applied to push the machine forward. It carries all of the Loomis improvements, including the loose crank, patent wheel rests, patent rope saver and standard rope divider.

Now Creeper Wheels

Creeper wheels are a track laying unit, built to creep over the top of mire and mud, hills and hollows without digging in. Since they lay their own track as they creep along, they are not dependent on roads. Should stones, holes, mounds, stumps, roots, refuse, etc. appear in their path, it is a simple operation for the creeper wheels to continue creeping over these obstacles with as much ease as though passing over an even road, as either side is right side up with this track. After they have passed over the earth several times you have a road where previously none existed. All material entering into their production is specially heat treated. They are so flexible that they can be moved by a push of the hand which is due to the simplicity of design and construction and the use of roller bearings. They are practically non-friction and non-clogging, making it possible to carry extremely heavy loads with quite a saving in tractor power.

Buckeye Discusses Cranes

The Buckeye Traction Ditcher Company is distributing a 16 page illustrated bulletin, devoted exclusively to the Model O Backfiller crane. On page two under the caption "All in a Day's Work," the many duties to which this machine may be adapted in one day are illustrated. Many of the pages are used to illustrate and describe the Model O as a backfiller, clamshell, ditcher dragline and crane. It is said to be light, speedy and low in both initial and operating cost and is designed to meet demands of the contracting and material handling fields for small portable units of power driven, labor saving equipment.

Portable Conveyor Data

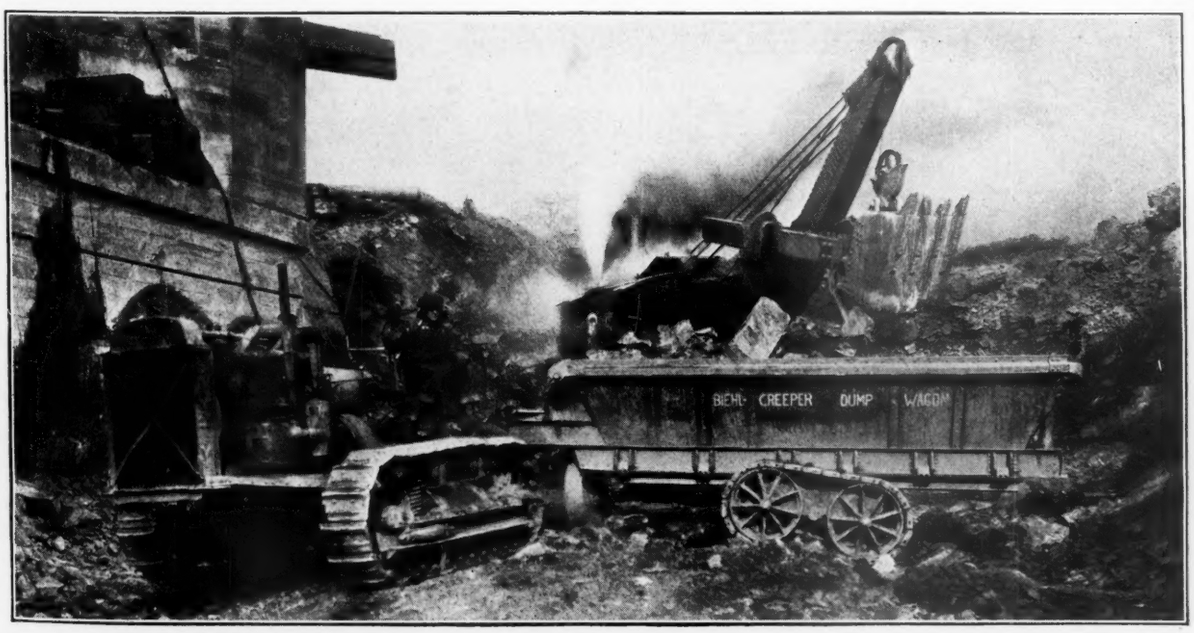
The Atlas Engineering Company is distributing its 16 page illustrated bulletin Number 26-B on portable belt conveyors. They are designed for moving or piling material, due to a large capacity for the required power and low cost of operation and maintenance.

The conveyors described are equipped with either electric or gasoline motor. All Atlas conveyors are built in multiples of 3 feet with 7½ foot head and foot sections and of all steel construction, driven through chain or gears. The loading hopper is of low type design with belt flashings. The head and foot pulleys are of one piece iron pipe and machine crowned, with cast iron end, forcing the belt to run true on the rollers. Carrier rolls are of the three roller troughing type of boiler tube with cast iron ends running on hollow pipe journals, which gives the belt a gradual dish. Special four ply rubber conveyor belting is used on all conveyors and all lubrication is done through Alemite industrial fittings.

Gravity Storage Bin Data

What is considered a complete, helpful, illustrated, 160 page catalog on the subject of "Gravity Storage Bins" is being distributed by the Neff and Fry Company. It outlines briefly the history of the development of the storage bin and some of the reasons. Among them was that the company engineers saw in advance through the tendency of larger buildings, the need for greater storage facilities. It began to build, improve and perfect a storage bin, embodying all the features of a skyscraper. During that period, it developed a great time saver, the gravity loading gate.

The catalog tells a story of the manufacturing processes and uses numerous photographs of the factories and equipment used. It includes illustrations of many installations in the United States and Canada, showing the various plans adopted in the installation to meet specific conditions and conveying the idea of their flexibility. Reproduced letters accompany many of the illustrations, which gives the engineer an idea of the regard in which gravity storage bins are held by those who have had them for a period of years. Since these installations were made, a new super concrete stave has been developed which is used in all installations and which it is believed will double the strength of the original gravity storage bins.



Loading Stone Into a Creeper Wheel Truck

Miami Line Described

The Miami Trailer-Scraper Company is distributing an illustrated bulletin describing its scrapers, winches, bulldozers and trailers of different kinds which may be adapted to various purposes. The bulletin illustrates each of these convenient machines in different classes of work and shows the accomplishments of each.

The scraper is used with the regular Fordson; the Fordson equipped with crawlers; Fordson equipped with Hamilton transmission; Cletrack 20K; McCormick Deering; and 2 ton caterpillar. Winches are manufactured and designed especially for use with any of the tractors and the Miami scraper. The bulldozer is power operated, the blade being controlled by the winch. It is stated that this machine will fill a trench 3 feet wide and 6 feet deep at the rate of 100 lineal feet per hour or handle from 50 to 60 cubic feet of dirt per hour.

A New Truck Hoist

A new H-2 hydro hoist has been recently designed, and is being manufactured by the Heil Company. It is intended to give operators a light duty power driven machine with similar advantages to the heavy duty dumpers, since it has the same gear principle.

A dumping angle of 56 degrees is possible with this hoist and a full load may be dumped in 5 to 9 seconds, depending on the motor speed. The racking of the truck body and frame is entirely eliminated with this hoist which is much speedier than the hand hoist and does away with the use of hand power.

It is said to be the only light duty hoist that can be disconnected from the lifting arm as one can disconnect it by loosening one nut. It can then be tipped back against the cab leaving the truck chassis open for servicing.

Cleveland Electric Appoints

The Cleveland Electric Tramrail Division of the Cleveland Crane and Engineering Company, Wickliffe, Ohio, announce the appointment of Leeds, Tozzer and Company, Inc., 75 West Street, New York, N. Y., as representatives of their Tramrail System in Manhattan, Bronx and Staten Island, New York

Wire Tension Indicator

The General Electric Company has developed a device for use in the repair of railway and industrial haulage motor armatures. It indicates the exact tension in pounds that is applied to the steel binding wire by the binding machine or lathe, and provides a simple means of keeping track of it throughout the full operation of binding up the armature. The essential characteristics of the indicator are as follows: It can be applied to practically any type of armature-binding machine; it is equipped with rotary dial which can be turned to any position by loosening a nut and setting the pointer at zero so that the scale may be read at any angle, allowing the use of any size binding wire within the range of the machine; the center pulley wheel over which the wire runs is actuated by a heavy coil spring so that when the binding machine or lathe is started and stopped, a constant tension is maintained on the wire at all loads.

Arnold on Special Work

After an absence of 20 years, Mr. E. E. Arnold has again become associated with the Westinghouse Electric and Manufacturing Company, in the capacity of Mechanical Engineer for special assignment. Mr. Arnold has a background of thirty years' experience in designing, testing, consulting and executive capacities pertaining to mechanical engineering.

Starters for D.C. Motors

A complete line of direct-current motor starters, designed to provide definite time acceleration for constant and adjustable speed motors, are divided into five types bearing the designations CR-4065, CR-4066, CR-4166, CR-4068 and CR-4168, has been introduced by the General Electric Company. The CR-4065 starter is a constant-speed type for general purpose applications, and the CR-4066 is the same type, reversing, with dynamic breaking. The CR-4168 is an adjustable-speed type, reversing, with dynamic braking and full-field features.

The enclosing case cover hooks over two pins at the top of the box. the bottom being held by a screw, in accordance with the Underwriters' requirements which eliminates thumb nuts and latches. On those starters provided with dynamic braking, a small relay is used to prevent the solenoid from being reenergized until the motor has come to rest.

S. H. Sutton Joins Amsco

Seymour H. Sutton, who recently joined the Pump Department of the American Manganese Steel Company, comes to Amsco with a wealth of experience and ability to assist sand and gravel operators to solve their pumping problems.

Graduating from Cornell University in 1911 with a degree in M.E., he joined the engineering sales staff of the Gould Pump Company, Contracting Engineers, Architects, Contractors and Dealers in the sale of power and hand pumps.

Leaving Gould, he spent eight years in the Engineering Department of the American Steel Foundries on construction and maintenance. He was then with the Peoples Gas Light & Coke Company, Chicago, for two years, promoting gas as against other fuels, and for two years Manager of the Erie Pump and Engine Works, manufacturers of centrifugal sand and gravel dredging pumps, in charge of sales, engineering and advertising.

In his present capacity, Mr. Sutton will be available to the Pit and Quarry Industries for engineering counsel and for sales data on the Amsco Line of Sand and Gravel Pumps.

Data From the Field

To comply with many requests from the field, Ingersoll Rand Company is distributing the sixth edition of its catalog "100 and 1 Ways to Make Money" in which considerable cost data, gathered from compressed air users, have been added. This 112 page illustrated catalog is replete with useful information on the use of portable compressors and pneumatic tools, paving breakers, rock drills, pneumatic diggers, pile drivers, hoists, tampers, hammers, surfacing machines, bonding drills, pedestal grinders, drill sharpeners, air saws and pneumatic wire brushes. The object is apparently to stress the use of portable air compressors but each of the tools mentioned is shown performing some useful task in an economical and efficient manner.

Trucks for Rough Usage

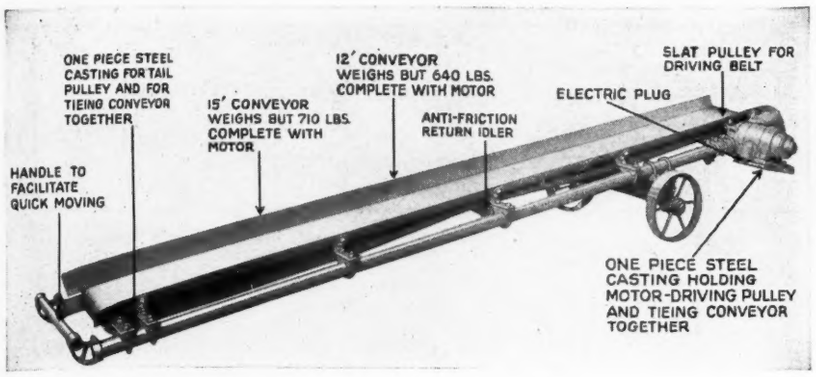
The Mack Motor Truck Company is distributing a 6 page illustrated bulletin entitled "The Gasoline Mule" which compares its product with a mule as regards its ability to absorb an abnormal measure of punishment. The photographs illustrate trucks which have been turned over, broken through bridges, fallen a distance of 35 feet and many other unusual damage causing incidents to prove that the truck has all the recuperative powers of the famous mule.

New Zelnicker Bulletin

Walter A. Zelnicker is distributing a bulletin mostly devoted to high class low priced used and reconditioned oil engines. It also includes oil engine driven generators and tanks.

New Link Belt Conveyor

The rugged construction for which Link-Belt machinery is noted has not been sacrificed in the design of their new "Jax" Conveyor.


ONE PIECE STEEL CASTING FOR TAIL PULLEY AND FOR TIEING CONVEYOR TOGETHER
15' CONVEYOR WEIGHS BUT 710 LBS. COMPLETE WITH MOTOR
12' CONVEYOR WEIGHS BUT 640 LBS. COMPLETE WITH MOTOR
ANTI-FRICTION RETURN IDLER
SLAT PULLEY FOR DRIVING BELT
ELECTRIC PLUG
HANDLE TO FACILITATE QUICK MOVING
ONE PIECE STEEL CASTING HOLDING MOTOR-DRIVING PULLEY AND TIEING CONVEYOR TOGETHER

Working Parts of Jax Conveyor

Built light enough so that one man can move it easily and quickly, it makes an ideal unit for unloading packages, bags, coal, rock, etc., on wharves from or to box cars, both indoors and out.

Mounted on agricultural type wheels of fourteen inch diameter and two inch face, a twelve foot conveyor, complete with motor, weighs but 640 pounds; and the fifteen foot conveyor, complete with motor, 710 pounds.

The wheels are movable to practically any point along the entire frame, which consists of two heavy pipes tied together at head and foot ends by electric steel castings. A pipe handle at the foot end facilitates ease of handling.

The casting at the head end provides a base for the motor and grease-tight enclosed housing in which the cut reduction gears operate. All shafts are provided with anti-friction bearings.

The height of the discharge point of the conveyor can be adjusted by moving the wheels forward or backward along the conveyor frame. The wheels are also provided with three positions for vertical adjustment.

Lubrication is seldom necessary as all bearings are of the anti-friction type, and all gears run in a bath of grease. The simplicity of design and construction of the conveyor plus quantity production permits its sale at a very low price.

New Zelnicker Bulletin

Zelnicker's bulletin 354 for the sand and gravel industry is being distributed, giving a list of all kinds of used and rebuilt equipment for the industries. Zelnicker is also distributor for Heisler Locomotive Works, Adamson-Fordson Locomotives and the Glover Machine Works.

Rebuilt Equipment Bulletin

The Southern Iron and Equipment Company is distributing its illustrated bulletin of rebuilt railway, logging, contractors and industrial equipment.

In addition, the bulletin advises that after forty years in the business of rebuilding locomotives, an entirely new department has been opened for manufacturing elliptical and semi-elliptical locomotive springs.

Rotary Clinker Scales

Under the title of "What Does Each of Your Kilns Produce," the Vulcan Iron Works has prepared a discussion of a new venture in its effort to serve the cement industry, clinker scales. The foremost thought in the design was to develop a machine that will keep an actual record of production on each burning and cooling unit. The machine is of simple design with few working parts and of rugged construction. The frame is made of heavy structural members, rigidly braced and riveted; the weighing drum is of steel plate; and the by-pass is of steel plate with easily removed liner. The scales may be used for weighing clinker, gypsum, lime or coal of temperatures not above 400 degrees Fahr.

Vulcan Rotary Clinker Scale

Rates for display advertisements in the Broadcast Section are given below. If you want to buy or sell used equipment, if you want a job or need a man, advertise your wants in Pit and Quarry. Advertisement copy for publication in the next issue should reach our office within one week after the date of this issue.

RATES PER INSERTION	1 Inch	2 Inches	3 Inches	4 Inches	5 Inches	6 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches	20 Inches	30 Inches
1 Insertion	$3.75	$7.25	$10.75	$14.25	$17.75	$21.25	$28.25	$31.75	$35.25	$42.25	$56.25	$70.25	$105.00
2 Insertions	3.75	7.25	10.70	14.20	17.65	21.15	28.15	31.65	35.15	42.15	56.15	70.00	104.00
3 Insertions	3.75	7.20	10.65	14.15	17.55	21.05	28.05	31.55	35.10	42.05	56.05	69.75	103.00
4 Insertions	3.70	7.15	10.60	14.10	17.45	20.95	27.95	31.45	35.00	41.95	55.90	68.75	102.00
8 Insertions	3.65	7.05	10.50	14.00	17.25	20.75	27.75	31.25	34.80	41.75	55.70	67.50	98.00
13 Insertions	3.60	6.95	10.40	13.90	17.05	20.55	27.55	31.05	34.60	41.55	55.55	66.25	94.00
26 Insertions	3.50	6.75	10.20	13.70	16.65	20.05	27.05	30.65	34.20	41.05	55.05	64.00	88.00

INFORMATION—*"Broadcast"* space is sold by the advertising "inch." Each page contains 30 inches. The width of the page is divided into 3 columns, each 2¼ inches wide. Each column contains 10 inches measured the length of the column. Any space may be used measured by the *even* inch in height (not fractions), by 1, 2 or 3 columns in width. The size of a space is its height in inches multiplied by the number of columns in width. Example: a space 3 inches high by 2 columns wide is 6 inches. Copy changes made without additional charge.

It Pays to Advertise in PIT and QUARRY

E. T. Walker, Centerville, Ohio, recently advertised several items of equipment for sale. Writing regarding the results he states: *"I desire to inform you that the results obtained were on the whole, very satisfactory."*

Complete Service Publishing Company

538 South Clark Street **CHICAGO**

Machinery for Sale

SPECIALS

1—New 8'x125' Allis-Chalmers Rotary Kiln

CRUSHERS

Crushing Rolls

1—8"x5", 2—14"x20", 4—24"x12", 1—26"x15", 1—30"x10", 1—30"x16", 2—36"x16", 1—42"x16", 1—54"x24".

Gyratory

All sizes from No. 2 Reduction to No. 12K.

Jaw

One 4"x8"—two 7"x10"—one 6"x20"—two 9"x15"—one 10"x20"—two 12"x24"—one 18"x36"—one 24"x36"—one 42"x30" Farrell—one 42"x36" Farrell—one 60"x84".

Rotary

Two No. 0, two No. 1, one No. 1½, and one No. 2 Sturtevant Rotary Fine Crushers.

Ring Roll

One No. 1 and one No. 2 Duplex Sturtevant ring roll mills.

Ball and Tube Mills

3', 4', 4½', 5', 5½', 6', 8' Hardinge Mills and Tube Mills.

DRYERS

One 3'x30', Three 4'x30', One 4½'x30', One 5'x40', One 5½'x40', One 6'x60', One 7'x60' and One 8'x80' Direct Heat Rotary Dryers, One 5'x25', one 6'x30', Two 8'x80' Ruggles Coles type "A" and One 4'x20' Ruggles Coles type "B" Double Shell Rotary Dryers.

KILNS

4'x40', 5'x60', 6'x60', 6'x70, 6'x90', 6'x100', 6'x120', 7'x80', 8'x125'.

MILLS

Two 33" and two 42" Fuller Lehigh Mills.
1 No. 0000, 1 No. 00, 2 No. 1, 2—4 Roll, and 1—5 Roll Raymond.
Swing Hammer Mills, Griffin Mills, Attrition and Cage Mills.
Air separators, Screens, Elevators and Conveyors.

The Heineken Engineering Corp.
Industrial Engineers
117 Liberty St., New York City
Courtlandt 5130

LOCOMOTIVES

1—56-ton 6-wheel Standard gauge Saddle Tank, new A.S.M.E. boiler, electric head lights, oil burning equipment.

LOCOMOTIVE CRANES

1—30-ton Ohio 8 wheel, double power drums, 50-ft. boom outriggers, factory rebuilt.
1—22½-ton Ohio 8 wheel, double power drums, 50-ft. boom, factory rebuilt.

CATERPILLAR SHOVELS

1—68C Bucyrus electrically operated shovel on caterpillars.
1—20B Bucyrus Steam Shovel on caterpillars.

Morris Engineering Co.
Phone: Cortland 0604
30 Church St., New York

CENTRIFUGAL PUMPS

10—Allis-Chalmers 10-in. suction and discharge Direct connected to 200 H.P. 3 phase, 60 cycle, 2200 Volt Motor, capacity 3500 G.P.M. at 180 ft. head.
12-inch Morris Steam Drive.

DREDGE PUMPS

15-inch American Manganese Dredge Pumps, direct connected to 500 H.P. 3 phase, 60 cycle, 2200 Volt Motor.
2—Morris 8-inch Steam Drive.

DRAGLINES

Class 24 Bucyrus Electric.
Class 14 Bucyrus Steam.

DUMP CARS

8—K. & J. 4 yd. 36-inch gauge.
4—Western 6 yd. standard gauge.

STEAM HOISTS

1—Stroudsburg 8¼x10 D.C., 3 Drum.
4—American 7x10 D.C., 2 Drum.
2—Lambert 5½x8 D.C., 2 Drum.
All with or without Boilers.

STONE SCREEN

Heavy Duty 3 ft. by 12 ft.
Roller Type A.C. Motor Drive.

For prices and information address

THE U. G. I. CONTRACTING COMPANY
Attention: Mr. R. C. Stanhope, Jr.
Supervisor of Equipment, U. G. I. Building,
Philadelphia, Penna.

CRAWLER SHOVELS

2—ERIE B-2 DREADNAUGHT, Steam Caterpillar, New 1926, 1-Yd. Dippers, HIGH LIFT; Overhauled, Like New.

1—50-B BUCYRUS, Steam Caterpillar; New 1927; 1¾-Yd. Dipper; Used few months; Perfect Condition.

1—OSGOOD HEAVY DUTY (1-Yd.) GASOLINE Caterpillar, 1-Yd. Dipper, HIGH LIFT, Excellent condition.

CRANES

1—NORTHWEST, Model No. 105, Gasoline Caterpillar Crane, New 1926, 40 ft. Boom, Bucket operating, Overhauled, Excellent condition.

2—25-ton, 8-wheel, INDUSTRIAL, Type G, Locomotive Crane, New 1927, 50 ft. booms.

DUMP CARS

25—5-yard, 36 in. gauge WESTERN, two-way side Dump, new 1927; STEEL DRAFT BEAMS; used few months, perfect condition.

GREY STEEL PRODUCTS CO.
111 Broadway New York, N. Y.

FOR SALE OR RENT

DUMP CARS

5—12-yd. Western, Std. Ga., Air. Perfect Condition.

GASOLINE SHOVELS AND CRANES

1—Link-Belt Comb. Gas-Crawler, 1-yd. Shovel and 15-ton, 50 foot boom Crane. Like new.
1—Northwest, Model 105, 50' Boom. 2-yrs-old.

STEAM SHOVELS

1—McMyler ¾-yd. Cat. Steam; also 40' Crane Boom. New 1927.
1—Marion, Model 32, 1¼-yd. Dipper, Full Cat., High Lift, Rebuilt 1927. Perfect shape.

GASOLINE LOCOMOTIVES

2—7-ton Plymouth, 36" Gauge. Like new.
1—8-ton Plymouth, 36" Gauge. Like new.

HOISTING ENGINES

1—40 HP. Mundy, DD, 2-ph., 60-cyc., 220-v.
1—22 HP. Lambert, DD, 2-ph., 60-cyc. 220-v.
1—7x10 Lidgerwood, DC, DD, Boiler mounted with Swinger attached

BOILERS

1—125 HP. Locomotive Type, ASME, 125 lb. Pressure.

TRACTORS

1—10-ton Holt, Gas. Cat.
1—5 2-ton Holt, Gas. Cat.
1—5-ton Holt, Gas. Cat.

B. M. WEISS
1324 Widener Bldg., Philadelphia, Pa.